THREE ESSAYS ON FINANCE AND ECONOMIC DEVELOPMENT

by

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ABSTRACT

There is a large body of literature stressing the importance of developing financial markets, including stock markets, to enhance countries' growth rates. In the first essay, I argue that the relationship between stock markets and growth is exaggerated and that the simple act of opening a formal stock market is not a good predictor of whether a country will experience economic growth. This is evaluated using two Bayesian econometric methods, Extreme Bounds Analysis (EBA) and Bayesian Model Averaging (BMA) by regressing growth between 2002 and 2007 on stock market openings between 1960 and 1999. The findings indicate that the opening of a stock market does not influence economic growth.

In the second essay the Schumpeterian innovation life-cycle is used to argue that firms will be more likely to raise funds through the stock market rather than the bond market if they are engaged in radically new technologies. This argument is placed within the context of the dominant theories of capital structure. Empirically, I test this relationship of innovative activity to equity issuance by using patents as a proxy for innovation from a dataset covering 1970 to 1992 regressed on whether a firm raised funds through the bond or stock market. I find statistically significant evidence using a dichotomous probit model that the industries with higher innovative/patenting activities are significantly more likely to raise funds through stock market issuance than firms without innovative activity.

The third essay evaluates the relationship between access to credit and the private credit to GDP ratio. I argue that two measures of inclusiveness, total access and the equality of access, are positively related with private credit and financial development. The newly released Global Financial Index database from the World Bank allows for the first time the ability to effectively test the impact of access and inequality of access. I find significant evidence that the total percentage of people in the financial sector is associated with, and unequal access to finance leads to, a lower private credit/GDP ratio.

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CHAPTER 1

INTRODUCTION

A developed and efficient financial system has a number of functions through which financial intermediaries are able to influence growth. According to the Levine (1997) classifications, these functions include allocating resources, mobilizing savings, reducing risks, facilitating transactions, and decreasing costs to monitor firms. Each of these functions plays its part in how financial development can influence growth. Gurley and Shaw (1955), Goldsmith (1969), McKinnon (1973), and Hicks (1969) argue that an efficient transfer of funds from surplus units to deficit units is necessary for stimulating economic growth. Without an efficient transfer of funds, entrepreneurs would be unable to obtain the necessary funds to expand their businesses, therefore lowering the level of growth. It is from this theoretical basis that this dissertation has emerged. The body of literature on the relationship between finance and growth would seem to suggest that financial development is the lynchpin to prosperity. Unfortunately, developing financial markets has not released the floodgates of economic growth. The essays contained herein evaluate the impact stock markets have as well as some specific conditions to better inform the development of effective financial systems.

Empirical work on the relationship between finance and growth did not emerge in earnest until the early 1990s. Following the work of King and Levine (1993)—where

they found that the initial level of financial development can predict later rates of economic growth—a number of studies emerge confirming the results that more financial development is associated with (or causes) economic growth. Within the finance-growth empirical literature, the research can be divided into promoting market or bank-based financial systems, whereby increasing either element should result in higher growth. Additional cross country results supporting the notion that increasing overall financial development include Levine (2002)—whose findings were that there is a strong connection between financial development and growth regardless of whether the country has a bank or market-based financial system—and Demirguc-Kunt and Maksimovic (2002), who showed that overall financial development helps to explain the growth of firms. These studies evaluated the financial system as a whole, while a number of other studies took a narrower approach by examining the role of stock markets. These results show that stock markets are positively associated with economic growth (Atje & Jovanovic, 1993; Demirguc-Kunt & Maksimovic, 1998; Levine & Zervos, 1998). It is this last category of research that has prompted many developing countries to open a stock market and expect economic prosperity to follow.

Alternatively, there exists a growing body of research questioning whether financial development is always and everywhere beneficial for growth. The idea suggested by Robinson (1952) is not that finance leads growth, but rather that financial systems act in response to economic conditions. As the economy is expanding, firms and households will have more demand for financial services. Responding to the increase in demand, more financial intermediaries and financial services will emerge. Outside of reverse causality, Lucas (1988) argued that finance is irrelevant for growth. He posits

that economists tend to overstate the impact of finance, and this idea was the reasoning for the exclusion of all financial considerations from a theoretical growth model.

While the dominant theme behind the relationship between finance and growth is of a positive causal relationship there exists a smaller, yet powerful literature contending that this is overstressed. For example, Ram (1999) used a sample of 95 countries, finding that the correlation is weakly negative or negligible. A number of other studies have been able to show that causality does not always run from finance to growth, with results being found that the direction of causality can also run in the reverse direction (Ang & McKibbin, 2007; Arestis & Demetriades, 1997; Demetriades & Hussein, 1996). The results provided by Arestis, Demetriades, and Luintel (2001) of banks being more effective in promoting economic growth—and arguing that the effects of stock markets on growth have been exaggerated by cross country studies—sets the stage for the first essay evaluating the impact of opening a stock market.

The three papers of my dissertation evaluate, theoretically and empirically, how certain elements of financial development achieve their aims. The first essay, "Stock Markets and Growth: A Re-Evaluation," fits into the literature evaluating whether stock markets are effective in promoting growth, finding insufficient evidence in support of the claims that the simple act of opening a stock market increases growth. The second essay, "Schumpeterian Innovation and Equity Issuance," furthers the first essay by evaluating particular circumstances where firms chose to raise funds through the stock market rather than bank channels. This is completed by presenting theory and evidence for the hypothesis that stock markets are more often used by firms in innovative industries rather than mature industries. The closing essay of the dissertation, "Private

Credit and Unequal Access," further evaluates the types of financial institutions most effective in facilitating growth. This is evaluated by using two new variables on the level of access to financial services regressed on the most widely used metric of financial development, private credit to GDP ratio. The robust results lend support for my hypothesis that higher levels of unequal access to finance leads to lower levels of private credit.

1.1 Stock Markets and Growth: A Re-Evaluation

Building on the large body of literature stressing the importance of developing financial markets, including stock markets, to enhance countries' growth, the first essay of this dissertation evaluates the link between the simple act of opening a stock market and economic growth. I argue that the relationship between stock markets and growth is exaggerated and that the simple act of opening a formal stock market is not a good predictor of whether a country will experience economic growth. While it is possible that in some instances opening a stock market can influence growth, I do not find any evidence that opening a stock market will have a broad impact.

This research uses two Bayesian econometric methods, Extreme Bounds Analysis (EBA) and Bayesian Model Averaging (BMA), to discover if there are meaningful links between opening a stock market and growth in developing economies. Superior to traditional cross-sectional regressions, these methodologies allow for determining the true impact of certain variables. The impact of opening a stock market is tested by regressing growth between 2002 and 2007 on stock market openings between 1960 and 1999. Using similar explanatory variables as many other studies, I find a zero, or weakly

negative, relationship between the opening of a stock market and growth in developing countries.

This essay finds that, on average, opening a stock market does not have any influence on growth, but does not show that stock markets will never influence growth. Stock markets may be more effective in countries with certain underlying characteristics. Intuitively, I believe that countries with higher levels of innovation will have conditions more amenable to an effective stock market. As such, determining when firms use stock markets to finance their activities is necessary. The second essay of the dissertation further evaluates this issue by positing that firms raise capital differently over the Schumpeterian innovation life-cycle.

1.2. Schumpeterian Innovation and Equity Issuance

I hypothesize that highly innovative firms—those with high risk, yet higher potential return—will be more likely to raise funds through stock markets than bond issuance. Using the Schumpeterian innovation life-cycle as a theoretical framework, I argue that in the beginning, a company with a radically new innovation is more likely to raise funds through equity issuance until it becomes an acceptable loan for bankers with a limited return (interest rate). This is all placed within the context of, and does not conflict with, the dominant theories of firms' capital structure: the Trade-Off, Market timing, and Pecking Order Models.

Empirically, I test this relationship of innovative activity to equity issuance by using patents as a proxy for innovation from a dataset covering the 1970 to 1992, encompassing 26,784 instances where firms raised funds through either the bond or stock

market. This independent variable is then regressed on the ratio of funds raised through equity to total funds raised. I find statistically significant evidence using a dichotomous, probit model that the industries with higher innovative/patenting activities are significantly more likely to raise funds through stock market issuance than firms without innovative activity.

The opening of a stock market is a distinct change in development; other changes in financial development are much more subtle. The measurement of financial development is difficult; as such, we as economists have created a number of metrics. The widest used variable in recent research is the private credit to GDP ratio. This variable has grown to being used as synonymous with financial development when evaluating the impacts of financial development on economic growth and other human development indicators such as inequality and poverty. Causality issues aside, it is important to understand the underlying elements of this widely used variable. As such, the third essay of this dissertation revisits Djankov, McLiesh, and Shleifer (2007) on the determinants of private credit by evaluating the equality of access to financial services.

1.3. Private Credit and Unequal Access

Building on the numerous studies evaluating how financial development affects economic growth, it is then important to understand important characteristics of financial development. One such characteristic of financial development is the level of access to financial institutions; increasing the level of access to financial institutions should increase the level of credit in the economy. In addition to access' impact on credit, the distribution of access across income groups is also important. Using the newly released

Global Financial Index database from the World Bank, this is able to be empirically tested for the first time. An additional contribution of this piece is through the construction of a new variable measuring the distribution of access among income groups. This differs from the traditional measurement of access as being the percentage of the population with accounts at financial institutions; my constructed metric is able to measure the percentage difference between having accounts at formal financial institutions between income groups.

The empirical section of this essay follows the model specifications as set forth by Djankov et al. (2007), using the same control and explanatory variables with private credit set as the dependent variable. Each individual model specification is identical, only adding the two access to finance variables. Essentially, I am able to replicate the results of Djankov et al., although the access variables begin to dominate the results of the other control variables, indicating that access is an important element behind the growth of the financial sector. While determining the exact institutional structure to influence the accessibility is beyond the scope of this essay, it is evident that bringing the poor into the formal financial sector is an important policy choice. The idea of promoting an inclusive financial sector would imply that opening a stock market would be unnecessary as the poor do not typically purchase common stock.

Within the topic of financial development, the three essays of this dissertation evaluate a separate issue in order to help determine the ideal policies for developing the financial sector of the economy. As will be seen, each of these essays substantially contributes toward our understanding of macro level financial reforms in developing countries. An interesting relationship between these essays is that the equality of access

to financial services is irrelevant for an effective functioning stock market. If opening a stock market was the gateway to economic growth, we would have found that formulating policies targeting the elite in the economy would be an ideal policy. However, we find the opposite result in that the equality of access matters and that simply opening a stock market is not enough to guarantee economic growth. Each of these essays opens the door for future research into effective ways to form financial sector policies. These avenues of future research will be discussed in the concluding remarks.

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CHAPTER 2

STOCK MARKETS AND GROWTH:

A RE-EVALUATION

2.1. Abstract

There is a large body of literature stressing the importance of developing financial markets, including stock markets, to enhance countries' growth rates. A number of empirical studies have come up with conflicting evidence as to how effective stock markets are in facilitating economic growth. Dominant economic theory posits that a stock market more efficiently allocates capital to productive projects. I argue that this relationship between stock markets and growth is exaggerated and that the simple act of opening a formal stock market is not a good predictor of whether a country will experience economic growth.

This is evaluated using two Bayesian econometric methods, Extreme Bounds Analysis (EBA) and Bayesian Model Averaging (BMA), to discover if there are meaningful links between opening a stock market and growth. In light of the conflicting results using classical econometric techniques, these Bayesian methodologies are able to reduce the uncertainty inherent in estimating any relationship. The impact of opening a stock market is tested by regressing growth between 2002 and 2007 on stock market openings between 1960 and 1999 using similar explanatory variables as many other

studies. While it is possible that in some instances opening a stock market can influence growth, I do not find any evidence that opening a stock market has any impact.

2.2. Introduction

There exists a large body of research on the relationship between finance and growth; much of this points to a positive relationship, where more developed financial markets are found in countries with higher levels of growth. The McKinnon-Shaw (Gurley & Shaw, 1955; McKinnon, 1973) hypothesis posits that efficient financial markets are able to mobilize savings and allocate capital to the productive sectors of the economy, therefore facilitating growth. That finance causes growth has been empirically displayed a number of times using different datasets and econometric methodologies (Demirguc-Kunt & Levine, 1996; Levine, 1991; Minier, 2009). The basic policy advice coming from this theoretical and empirical literature is to develop financial markets and watch the economy grow. However, not all researchers are convinced that the relationship is as clear cut or that the direction of causality is accurate (Lucas, 1988; Ram, 1999; Rousseau & Wachtel, 2005). Joan Robinson posited that financial services act as a response to economic conditions, where markets will develop in order to accommodate a growing economy (Robinson, 1952). While it is acknowledged that efficient financial markets help to facilitate transfers of capital to productive sectors, the narrower impact of stock markets is not so certain. Stock markets facilitate funds transfers to a different set of companies and investors than banking channels do. The operation of a stock market may not provide a net benefit if banks are able to provide the services necessary (Arestis, Demetriades & Luintel, 2001). I argue that the relationship

between stock markets and growth is exaggerated and that opening a stock market is not a good predictor of whether an economy will grow.

On the heels of the financial development literature and the dominant ideology of the liberalization of capital and trade accounts, policy prescriptions pushed the opening of stock markets. These recommendations precipitated the large number of openings during the 1990s, as shown in Figure 2.1. That so many stock market openings occurred in the 1990s out of distinct policy changes is indicative that these openings were not driven by economic growth. The dominant ideology of the period was that the absence of a stock market hindered growth opportunities that could be partially solved by the opening of a formal exchange. The number of openings during this period provides a natural experiment in the effect that if stock markets do cause economic growth, the periods subsequent to the openings should be accompanied by per capita growth. For this reason, I am empirically testing whether the act of opening a stock market has had a subsequent impact on the economies of various countries.

In empirically testing whether the simple act of opening a stock market influences growth, I use two complimentary Bayesian methodologies—Extreme Bounds Analysis (EBA) and Bayesian Model Averaging (BMA). EBA is a global sensitivity analysis able to determine the precise bounds a variable can take based on a given dataset. This is a robustness check in that many variables can have coefficient values that are both positive and negative. Knowing the bounds allows for the conclusion that, given a dataset, some variables will always carry a positive or negative coefficient. If a variable has bounds that do not cover zero, there is no question as to its relationship. BMA compliments this methodology because of the uncertainty inherent in model selection. Debate often arises

over use of certain variables, or combination of variables, in model specifications. To alleviate some of the uncertainty, BMA computes the probability that a particular model will be the best model given the dataset. Then, based on the models selected, BMA takes a weighted average to find the posterior distributions of the variables. Rather than relying on *T*-statistics, BMA assigns the probabilities that variables are statistically different from zero. Ranging from zero for a variable that does not appear in any model specification to one for a variable in every selected model, the variables considered to be more important in the determination of the dependent variable will have higher posterior probabilities.

The empirical results of this paper are straightforward. I find little evidence that the act of opening a stock market has any influence on growth. This result holds with the use of each of the estimation methodologies. The values of opening a stock market are fragile with extreme bounds falling on both sides of zero. BMA finds that the two measures of stock markets have posterior probabilities of 0.0 and are not statistically different from zero. In fact, BMA does not select either variable to be included in *any* of the top models selected. Neither methodology is able to find any evidence that the opening of a stock market has any influence on growth.

The essay is organized first by discussing the theoretical and empirical literature on broadly measured financial development, followed by a targeted discussion on the impacts of stock markets on growth. The empirical section follows with a detailed explanation of the Bayesian techniques used, presenting evidence that the impact of opening a stock market has little impact on growth.

2.3. Finance-Growth Nexus

Early theorists, such as Gurley and Shaw (1955), Goldsmith (1969), and McKinnon (1973) (formulating what is known as the McKinnon-Shaw hypothesis), argued that a developed financial sector is a crucial element in economic growth. The process of channeling funds from surplus units with excess capital to deficit units in need of capital should lead to increased productivity and growth. The McKinnon-Shaw hypothesis argues that an underdeveloped financial sector will constrain growth since entrepreneurs with profitable opportunities would be unable to access the capital necessary to grow their company, leaving numerous growth opportunities unexplored. Hicks (1969) argument is similar in that within development, the financing of innovative technologies is crucial, but requires an illiquid investment with higher risks to investors. The introduction of efficient financial markets has the effect of lower costs of financing these enterprises through increasing liquidity, resulting in higher levels of capital available to entrepreneurs. Lessening financial constraints for technologically advanced firms will lead to increased productivity and growth.

Extending the McKinnon-Shaw hypothesis, further benefits of financial development have been identified and synthesized into three main functions. These are to allocate resources, mobilize savings, and reduce risks. Tobin and Brainard (1963) argued that well-functioning financial systems will lead to a more effective allocation of capital. In efficient capital markets, investors are better able to evaluate investments, thereby allowing entrepreneurs the ability to access capital at more favorable terms. This allocative efficiency is attained through the ability of financial intermediaries to obtain information at lower costs and being able to move faster to fund profitable projects.

Wicksell (1935) theorized that financial markets play the important role of matchmaker between savers and borrowers. The savings of individual households are typically not enough to fund large projects, so financial intermediaries have the ability to pool capital, making the entire aggregated amount available for lending. Many profitable investments require long-term commitment, but many investors are wary of tying their capital up for long periods of time. Whereas an underdeveloped financial system would require investors to invest over the long run, developed and liquid financial markets allow investors the ability to liquidate their investment in the event they need cash quickly. Liquid financial markets allow for the long-term financing of projects with short-term capital.

Building on the early theoretical literature on the finance-growth nexus, empirical studies emerged in earnest in the 1990s. Prominent work by King and Levine (1993) supports the view that financial development positively influences growth, controlling for other factors that affect long-run growth. This study focused on banking variables, including credit to the private sector divided by GDP, to proxy for the level of financial development, and setting the dependent variable as economic growth. Demirguc-Kunt and Maksimovic (1998) extend this by showing that countries with more efficient legal systems will have more firms using funds from financial institutions. In an environment with an effective legal system and well-functioning financial markets, the countries experienced higher levels of productivity of capital, facilitating firm growth. The empirical work on countries' legal origins positively influencing financial development and economic growth has been confirmed a number of times using cross-sectional

(Levine 1998, 1999), time series (Djankov et al. 2007), and dynamic panel (Beck and Levine 2002, 2004; Levine, Loayza & Beck, 2000) methodologies.

While the relationship between finance and growth was becoming well known, the early studies did a poor job of correcting for endogeneity; the assessment of causality was setting up cross-sectional regressions and concluding that the explanatory variables caused changes in the dependent variable. Thus the need to account for endogeneity issues was accomplished first through the use of instrumental variables. Demirguc-Kunt and Maksimovic (2002) and Levine (2002) find, using legal structure as an instrumental variable, that the development of financial markets influences the level of economic growth. Both studies' results did not provide different results for firms' access from either a bank or market-based financial system; it did not matter what the primary source of financing is, but rather how developed the financial systems are. Strengthening the results, a number of studies assessing the causality have arisen using time series models. For example, Choe and Moosa (1999), using VARs and Granger causality, found that causality runs from financial development to Growth during the period 1970–1992 in Korea. This result primarily supported the role of financial intermediaries rather than capital markets.

While a large amount of literature finds a positive relationship between financial development and economic growth, not all researchers share this opinion. A number of studies propose that there are specific conditions where financial development will positively influence growth. Rousseau and Wachtel (2002), using a fixed effects panel model, found that in countries with high inflation, financial development does not seem to increase growth. The inflation threshold is that in countries with annual inflation rates

under 8%, the effects of financial development are significantly positive; conversely, when inflation rates are above 13%, there does not appear to be a relationship, while inflation rates in between are ambiguous. Rioja and Valev (2004) found that financial development's influence depends on how developed the countries are when implementing the reforms. Using a Generalized Method of Moments (GMM) model, Rioja and Valev divide their sample of 74 countries into three groups based on their starting level of financial development. Their findings indicate that finance has a robust positive impact on countries that are already well developed, while an ambiguous relationship exists in less developed countries. These threshold results are also found by Deidda and Fattouh (2002) regarding the level of per capita income. With the full 80 country sample, a positive relationship between financial development and economic growth is found. However, financial development appears to only influence growth in wealthier countries, but not in low income countries. These results all present evidence that financial development is not a blanket solution that helps every country in every situation; they highlight that there are circumstances where financial development may be beneficial and others when it is not.

In light of the studies finding that finance is not a blanket solution to development problems, a number of researchers contend that financial development is irrelevant, having no influence on growth. A famous example is the Robert Lucas comment that finance is "very badly overstressed" and "is not inclined to be apologetic" for its exclusion from his growth model (Lucas, 1988, p. 6). This opinion is empirically supported by Ram (1999) who, in using a sample of 95 countries, finds that the correlation between financial development and growth is weakly negative or negligible.

There were also similar findings when separating the countries by income cohorts as well as grouping the countries according to growth rates. Extending the research contesting that financial development may not be the gateway to growth, Rousseau and Wachtel (2005) examine the relationship between financial depth and economic growth using cross sectional and panel data for 84 countries between 1960 and 2003. Three different measures of financial depth were used, with the updated time period not presenting as robust of findings as earlier studies. Their principle finding is that while the relationship may have existed through the early 1990s, it appears to have diminished in the later periods. The authors compared the relationship between finance and growth to the Phillips Curve, where an observed relationship was believed to be an empirical regularity before the relationship disintegrated. These conclusions were to act as a reminder that the correlations between finance and growth may well represent cross-country differences rather than a causal relationship.

Although a statistical relationship between finance and growth may exist, some theorists question the direction of causality. Joan Robinson contended that finance does not lead growth, but rather that financial systems act in response to economic conditions (Robinson, 1952). As the economy is expanding, firms and households will have more demand for financial services, which will be provided by profit-seeking financial institutions. A number of other studies have been able to show that causality does not always run from finance to growth, with results being found that the direction of causality can also run in the reverse direction (Ang & McKibbin, 2007; Demetriades & Hussein, 1996; Demetriades & Luintel, 1996). Arestis and Demetriades (1997) find that causality varies substantially across countries. Their results showed that in Germany, causality

runs from financial development to growth, while the opposite result was found for the United States for the period 1979 to 1991.

2.4. Stock Markets and Growth

Where many of the above studies evaluate the link between financial development and growth, our concern is specifically related to how—and whether—stock markets can facilitate economic growth. The theoretical basis behind the introduction of stock markets largely follows the McKinnon-Shaw argument behind the development of financial markets. Specifically, the opening of a stock market will increasingly allocate capital for long-run investments with short-run capital due to the ease with which investors are able to remove their investment. This should effectively reduce transaction costs, increase capital accumulation, and lead to higher levels of economic growth. Building on the early theoretical work on the relationship between finance and growth, Levine (1991) expands the McKinnon-Shaw hypothesis to specifically model stock markets' impact on per capita growth. This model is able to demonstrate that stock markets help to facilitate technological innovation and economic growth through an easy transfer of ownership that does not disrupt the productive capabilities or cash flows of firms. Levine emphasizes the positive impact of stock market liquidity on long-run growth, empirically showing that taxes on stock market transactions are associated with lower economic growth.

Atje and Jovanovic (1993) have similar findings in that stock markets are associated with higher income levels as well as positive economic growth effects. This finding supports the view that of the elements of financial development that are most

effective are stock markets as similar growth effects were not observed for bank lending. These empirical results were performed in a similar manner to Levine (1991), evaluating liquidity for a sample of 94 countries with annual observations during the period 1960–1985. Levine and Zervos (1998) and Rousseau and Wachtel (2000) expand the sample size of the earlier studies and, using different econometric techniques, come to similar conclusions as the earlier studies. Both papers show that stock market liquidity and banking development can predict growth levels. On the other hand, neither study was able to find evidence that stock market capitalization as a percentage of GDP has a relationship with growth. Levine and Zervos (1998) were also unable to find evidence that any of the financial indicators used had any relation with private savings rates, concluding that the data showed that stock markets play a different role than banks. Acknowledging that banks and stock markets play different roles, Arestis et al. (2001) finds that both stock markets and banks are able to promote economic growth. However, using a time series analysis over the period 1972–1998, the authors find that the stock market provides relatively little impact on growth as compared to that received from banks. They argue that the impact of stock markets is exaggerated by the use of cross-country growth regressions.

Directly assessing the possible endogeneity between stock market development and growth, Caporale, Howells, and Soliman (2005) found that causality runs from stock markets to growth. These results were found using Vector Auto-Regression models and WALD tests to the effect that growth is influenced through effects on investment efficiency. Bringing capital to the firms in technologically advanced industries with high profit opportunities is a fundamental reason behind why stock markets should exist.

Beck and Levine (2002) support the notion of stock markets' principle purpose being to channel funds to high productivity sectors. Empirical results showed that a more developed financial system is correlated with higher levels of economic growth regardless of whether the country's financial system is bank-based or market-based as each type of financial service is designed to accommodate different sectors. These results are also unable to find evidence that stock market capitalization causes higher levels of economic growth, concluding that it is not the number of companies listed on the stock exchange, but rather it is that the stock market exists. The size of the stock market is irrelevant to growth so long as it is able to facilitate the transfer of capital to the high productivity sectors.

The question of whether it is the size of the stock market or whether its existence is the important factor has begun to be addressed in recent years. Baier, Dwyer, and Tamura (2004) evaluated the effect of opening a stock market on productivity growth as measured by total factor productivity (TFP) and its subsequent impact on economic growth. They argued that the mechanism through which a stock market influences economic growth is not through capital accumulation, but is from changes in the growth rate of productivity. Baier et al. did not find any statistical difference in economic growth in the periods before and after the stock market opens. The support they found for opening a stock market is that productivity growth (TFP) increases in the period after the opening. However, they did acknowledge that point estimates suggest that countries have slower economic growth after opening an exchange. Even in the presence of conflicting results, they concluded that opening an exchange generates faster productivity and economic growth. Minier (2009), on the other hand, looked directly at the effect a

stock market had on growth, showing a statistically significant positive result of growth in the first 5 years after opening a stock market. This study was conducted by comparing growth rates for the 5 years before and after the opening of the stock market. Enders (2004) has shown that such tests are poorly designed because successive values of GDP are serially correlated; some of the effects of a pre-stock-market economy could carry over to the period after the stock market is opened. Baier et al. (2004) and Minier (2009) provided evidence that the opening of a stock market has a positive impact on productivity and growth.

In contrast to these studies promoting the benefits of opening a stock market, a number of researchers have theorized and provided empirical results questioning the efficacy of opening a stock market. The most prominent is that of the destabilizing effects of opening a stock market. Keynes (1936) has argued that stock markets present too many speculative opportunities that are not complimentary to a stable, growing economy. Keynes' view was that stock markets were like a casino in which investors placed bets without full knowledge of the underlying components, pushing asset prices away from their fundamental value. After it is realized that these prices are above their fundamental value, the readjustment can have serious consequences on the real economy. This sentiment is echoed by Kindleberger (1978) where excessive speculation and high levels of leverage can cause a mania to occur. The immediate result is pushing asset prices up before a sudden loss of confidence causes a panic in the market where, if not controlled, can spiral into a crash. The instability of financial markets, contend Keynes and Kindleberger, can bleed over to the real economy as investors will remove their funds from being able to be put to productive use because of fear of losing their

investments. As such, firms become constrained by not being able to access capital, resulting in depressing the economy. Both felt as though the benefits of stock markets may not outweigh the costs to the economy.

Where many of the studies pointed towards stock markets benefits being increased liquidity and the ease with which investors are able to remove their capital, Bhide (1993) found increased liquidity in stock markets holds hidden costs. His findings indicated that liquidity discourages internal monitoring because of information asymmetry problems. With a liquid market for a company's stock, there is little incentive for stockholders to monitor the firm's managers since dissatisfied investors have the ability to quickly rid themselves of their holdings at little cost. That a liquid market discourages monitoring by large investors causes a societal drag in that agency costs are amplified. These results were surprising to many, yet were subsequently supported. Harris (1997) found that the relationship between stock market activity and growth is weak at best for developing countries. He did find that there is a positive and statistically significant result for stock market activity on growth in the developed countries, but he "… finds no hard evidence that the level of stock market activity helps to explain growth in per capita output" (Harris, 1997, p. 139) for anyone other than the most developed countries. Harris' sentiments were echoed by Singh (1997), who argued that the expansion of stock markets through the 1980s and 1990s in the developing world hindered rather than assisted growth and development. This result insists that the opening of a stock market undermined the benefits accrued from removing the financial repression policies within developing countries. Singh also provided numerous historical

examples of economies that experienced high levels of growth in the absence of a functioning stock market.

In light of the conflicting evidence on the impacts of opening a stock market, the question of whether the simple act of opening a stock market even influences growth is not solved. I hypothesize that the relationship between the simple act of opening a stock market and growth is overstressed. That there was a large number of openings in the 1990s indicates that these were not "organic" in the sense that this were distinct policy choices rather than emerging as Joan Robinson hypothesized that financial systems arise out of necessity to accommodate a growing economy. These were distinct policy choices essentially saying "open a stock market, the economy will grow" rather than emerging out of a growing economy. This acts as a natural experiment as we are able to test whether these openings have resulted in increased growth for these countries. I am empirically testing whether the countries that opened a stock market had higher rates of growth relative to the countries without a stock market. This will be able to effectively test whether it is the presence of a stock market that increases growth.

2.5. Empirical Methodology

While a number of empirical studies point to a positive relationship between financial development and growth, there is a sizable literature contending that the relationship is irrelevant at best and negative at worst. This uncertainty is not unsurprising due to the numerous empirical methodologies and datasets that are used in the literature. Bayesian econometric methodologies have arisen to address these issues surrounding model uncertainty. Depending on the methodology employed, parameter

estimates can change, especially considering a total of 2^k different specifications are possible (where k is the number of explanatory variables). Since we are uncertain of the specific impact of certain variables on our dependent variable, Bayesian statistics assigns probabilities. Changing model specifications can lead to changes in maximum likelihood estimates, which is addressed through the generation of models and variables with higher posterior probabilities.

In order to address this uncertainty surrounding the impact of opening a stock market on growth in poorer countries, I use two complementary Bayesian methodologies: Extreme Bounds Analysis (EBA) and Bayesian Model Averaging (BMA). EBA is able to compute the range of possible values of maximum likelihood estimation over every possible model specification and all specified combinations of explanatory variables. Knowing that these extreme bounds (minimum to maximum) cover every possible value a coefficient may take, given a set of variables, is a stringent test. In order to "pass," the variable's bounds must not cover zero, being either strictly negative or positive. The result is that those variables that do pass are statistically different from zero, being concluded that this relationship will be different from zero given the data and specifications. BMA is also able to address model uncertainty by averaging over a set of Bayesian estimates and assigning posterior probabilities of a specific model being the best fit. BMA then averages the coefficients of variables for the models they appear in. These estimates are a posterior distribution, with the posterior mean being the expected value (EV) of the variable. BMA also relies on assessing the posterior probability that the variables' impact is not zero; variables not included in any models are assumed to have a minimal impact as they would have a posterior probability of zero.

I estimate an empirical growth model paying special attention to the impact of stock market openings. Levine and Renelt (1992) examined the empirical work on growth using a new (at the time) procedure known as Extreme Bounds Analysis to test for robustness on the empirics of the growth literature. Results from these estimations were that most variables were fragile, only finding two robust correlations with growth: share of investment in GDP and ratio of international trade to GDP. Sala-i-Martin (1997) acknowledged the benefits of the approach, but provided strong criticisms, saying "…the test is too strong for any variable to pass it….Thus, giving the label of non-robust to all variables is all but guaranteed." (Sala-i-Martin, 1997, p.179) He then averaged over two million regressions a likelihood-weighted sum of normal cumulative distribution functions. This rudimentary approach was the predecessor of Sala-i-Martin, Doppelhofer, and Miller (2004), which used a model averaging approach known as Bayesian Averaging of Classical Estimates (BACE). This process takes the Bayesian concept of averaging across models and combines it with classical OLS estimations. Adding to the literature on Bayesian estimations of growth theory is Fernandez, Ley, and Steel (2001), who used Bayesian Model Averaging to confirm the conclusions of Sala-i-Martin (1997) in that some variables are robust, having some explanatory power, rather than the limited conclusions of Levine and Renelt (1992). Applying BMA to the Sala-i-Martin dataset reduced much of the uncertainty of the initial estimates. Fernandez went substantially further as clear interpretations of the data were able to be inferred.

This paper takes a purely Bayesian approach, combining the well-known techniques used by Levine and Renelt (1992) and Sala-i-Martin et al. (2004). Where my approach differs from Sala-i-Martin et al. (2004) is that instead of averaging over

classical estimations with BACE, I use Bayesian Model Averaging (BMA) which averages over Bayesian estimates. BACE is derived from this purely Bayesian technique of BMA and is typically used when presenting to those not familiar with Bayesian techniques. The reason for the divergence is that BMA is better equipped to handle model uncertainty. Additionally, the strength of statistical packages (R) in recent years has allowed for the creation of detailed image plots for a more intuitive presentation of the results. Given the Sala-i-Martin (1997) criticisms discussed earlier of the Extreme Bounds approach, it is still a useful tool and, combined with BMA, presents a compelling way to view the data. If a variable is robust with bounds that do not cover zero, it is then absolutely certain of the direction of correlation. This combination of techniques uses EBA to test for robustness and BMA for assessing "importance." There are numerous studies evaluating the determinants of growth, but I make no attempt at reconciling them. While some results are presented on the relationships between certain indicators and growth, the impact of this paper is the determination of whether the simple act of opening a stock market can positively influence growth.

2.5.1. Extreme Bounds Analysis

The variations in empirical results summarized in the literature above are not surprising. Econometric analyses often differ due to varying data, model selection, or statistical techniques. In this paper, I begin with a global sensitivity analysis as introduced by Leamer (1978, 1982, 1983, 1985, 1997). Extreme Bounds Analysis (EBA) is a Bayesian methodology of global sensitivity analysis able to compute the range of values of a coefficient. This is done in the context of linear regression models by

computing the extreme values using maximum likelihood estimation procedures under all possible combinations of variables in the dataset. EBA computes coefficients for all possible linear combinations for a set of variables; the extreme bounds are the maximum and minimum posterior mean estimates. This methodology is a rigorous test of robustness as few variables are able to survive and show a definitive impact. EBA computes the possible bounds for the posterior mean for a normal linear regression model, given by the standard equation:

$$Y = X\beta + \varepsilon \tag{2.1}$$

In this equation, the X matrix contains the variables to be included in the model specification. In EBA parlance, these variables are referred as being "free" variables. Free variables are those that are not properly specified and not associated with a prior specification. These variables are those that would typically be included in a model specification. These would be the list of variables that would be reported in the final results, while showing combinations within this set. This X matrix would also necessarily include the variables of interest in addition to the control variables. The selection of these variables would be to include those variables traditionally used in a classical model specification within the literature.

As with any model specification, the selection of variables is subject to debate as any combination of variables (sometimes selected in a seemingly arbitrary way) can be used. However, there always exist additional variables that could be included in a model specification. When we exclude a variable from a model, the expected impact of this

variable on the dependent variable will be precisely zero. In this way, all regressions use priors; excluding a variable from a model essentially says that the econometrician believes the variable is not important and will not be considered to have an impact. The problem is that some of these variables can alter the impact of variables in the X matrix on the dependent variables. EBA is able to account for the range of values the explanatory variables will have on the dependent variable. The variables that are typically dropped in a model specification are referred to as "doubtful" variables and are added to the standard linear regression as the Z matrix.

$$Y = X\beta + Z\Gamma + \varepsilon \tag{2.2}$$

Interest is in the set of β coefficients, but the selection of variables in the Z matrix are able to influence the range with which B values are able to take. The choice of a set of Z variables, called "doubtful" variables, allows for the calculation of the extreme posterior values for the coefficients associated with the X variables. That sets of variables (Z) might be dropped from a regression induces a coherent prior, rather than an improper prior for free variables, on the coefficient vector, Γ. Whereas in traditional cross-sectional specifications we would just drop these variables, they are still included as doubtful variables to see their influence on the free variables. Setting a variable to doubtful is a twist on proper prior specification by setting the prior mean equal to zero, representing the belief that these variables could be dropped from the model specification. Because the mean of these doubtful variables is set at zero, the doubtful

variables' extreme posterior means would necessarily include zero. For this reason, the variables of interest must always be free; otherwise, they would never pass.

With a large number of explanatory variables there are an exponentially large number of doubtful/free combinations. As such, we group variables into various categories according to our prior beliefs about their impact. The combinations would start with including only the variables of interest as the free variables, with all others set as doubtful. This will give the widest bounds as the combination of explanatory variables is the greatest. The other combinations would be to include a set of variables that are typically included in a classical estimation as free. There are circumstances where debate about the types of variables are most important arise; a solution with EBA would be to use one set of variables as free, with the others doubtful in one specification and switching these around for the next. Using every possible combination of variables is cumbersome and unwieldy, so the selection of variables must be reduced to a reasonable number.

2.5.2. BMA Overview

The second estimation procedure used is Bayesian Model Averaging (BMA) as discussed by Raftery, Painter, and Volinsky (2005) and Hoeting, Madigan, Raftery, and Volinsky (1999). Since EBA provides the bounds a coefficient can take, BMA quantifies the value of many different models to compute the posterior distributions to help select the best models. These Bayesian methodologies are complementary in that one checks and verifies robustness, while the other ranks models according to their explanatory power. In econometrics, one of the most difficult and contentious issues is in model

selection. This uncertainty can lead to misspecification errors and erroneous conclusions. A major issue in the use of linear regression models with ordinary least squares is that the inclusion of additional variables is not discounted in the search for a high R^2. With the rise of high computer power and statistical software it becomes possible to run thousands of models while adding or subtracting variables until the desired result is discovered (as shown by EBA). In BMA, however, the economist reduces this uncertainty by including all variables that could have an impact and allowing an established algorithm to select the most appropriate models.

Utilizing the leaps and bounds algorithm developed by Raftery et al. (2005), the exponential number of models is reduced to a workable model space. Leaps and bounds returns a set of the best models that are then ranked according to their Bayesian Information Criteria (BIC). These models that make it in the set of best models are assigned posterior probabilities of being the best model out of the set. Those ranked higher, with lower BIC values, receive higher posterior probabilities. The variables included in these models are assigned posterior probabilities of being included in the best models, with coefficients being the posterior distributions. This differs greatly from the traditional quest for statistical significance in that rather than arbitrarily adding or subtracting variables, the established algorithm chooses the most representative models.

Underlying BMA is the desire to average over all possible models. However, the computations required to perform the exponential number of computations is unwieldy and was long limited by computing power. Two difficulties for the implementation of BMA arise; the first involves computing the integrated likelihood function, which is obtained by integrating the unknown parameters. The second is averaging across all

models, which is exponentially large. The first computational problem is solved by using the BIC approximation that does not rely on difficulty to compute high dimensional integral, while the second is corrected by the leaps and bounds algorithm. It is unnecessary to compute the models that stand no chance of being the best model. Thus arose the need to reduce the number of models into a workable set, rather than the exponentially large number of models to average across. Reducing the models is accomplished by the fast leaps and bounds algorithm as introduced by Furnival and Wilson (1974), and made applicable to BMA by Raftery (1995).

Once the models have been narrowed down, selection of the best models comes by way of using the Bayesian Information Criteria (BIC). This process is similar to evaluation by the Akaike Information Criterion (AIC) but differs in that the penalty for adding variables under BMA is much less than under AIC. The following equation gives the calculation for BIC where R_k^2 is the value of the computed R^2 and $p_k$is the number of independent variables regressed on model *k*.

$$BIC_k = n\log(1 - R_k^2) + p_k \log n \tag{2.3}$$

Adding variables is discounted in BMA as the models are penalized for adding explanatory variables and rewards models with better explanatory power. The lower the value of BIC, the better the data fit, with the best model having the lowest BIC. Ranking the models according to BIC solves the primary problem of computing integrals in multiple dimensions. After the reduction of the model space and ranking of models according to BIC, it must be acknowledged that the top ranked model may not represent

the data the best. For those things we are uncertain about, we assign probabilities. As such, we are able to compute posterior probabilities that a particular model will be the best.

In a BMA analysis, there are two posterior probabilities that are computed. The first is the probability that a particular model specification will be the best, while the second is the probability that a specific variable will be in the model that tells the best story. Posterior probabilities of being the best model are calculated as

$$p(\Delta|D) = \sum_{k=1}^{k} p(\Delta|D, m_k)p(m_k|D) \quad (2.4)$$

where Δ is the unknown quantity of our dependent variable and D is a given matrix of available data. $p(\Delta|D, m_k)$ is the posterior distribution of Δ given the model m_k and $p(m_k|D)$ is the posterior probability that m_k provides the best fit. BMA determines this posterior distribution of Δ as a weighted average of the posterior distributions of the models. The models with the lowest BIC will have the highest posterior probabilities down to the lowest probabilities being assigned to the lowest ranked model in the reduced leaps and bounds model space.

Once the posterior probabilities of the models being the best fit have been calculated, BMA computes the posterior probabilities of the individual variables. The computations are the probability that the coefficient attached to the variable is *not* zero. The higher this value is, the higher the likelihood that the variable differs from zero. Variables with posterior probabilities of 100% are included in every model. The posterior probabilities of differing from zero are the sum of the model posterior

probabilities the variables are included in. Variables with posterior probabilities equal to zero are not included in any models and, with the employed data set, cannot be concluded to have much of an effect on the dependent variable. The expected values of the coefficients are referred to as the posterior mean, which is a weighted average of the posterior means from each model. These values are weighted by their posterior probabilities, where those with a higher likelihood of being in the best model carry a higher weight on the posterior mean. For variables with little impact, these posterior distributions will be centered on zero. The lower the posterior probability, the higher the likelihood is that the variables impact will have no effect on the dependent variable. For the variables that are statistically different from zero, the density of the coefficients should fall on either side of zero. The standard deviation provides for a level of confidence that the distribution is significantly different from zero. If a one standard deviation change from the posterior mean does not cover zero and the variable has a high posterior probability, it can be considered an important indicator.

2.6. Data

If stock markets are able to promote, or stall, growth, the opening of a stock market should see subsequent changes in growth rates. The conditions through the 1980s and 1990s that saw a large number of stock markets open was a distinct change in sentiments rather than emerging out of a growing country's need for additional financial services. As such, this natural experiment allows for the empirical testing of whether a stock market impacts growth. In formally testing my hypothesis that opening a stock market does not create a positive shift in economic growth, I use both EBA and BMA

methodologies. I use a dataset with 82 countries and 32 independent variables that are typically found in the finance-growth literature. This dataset will serve both EBA and BMA methodologies. Stock markets have been hypothesized to be able to increase growth through a number of mechanisms and should be accompanied by a permanent increase in growth. The absence of differences in annual growth rates would be indicative that just opening a stock market is not enough to cause growth. Conversely, a negative relationship would provide evidence that the speculative costs of stock markets outweigh the benefits.

The dependent variable in this study is the average annual per capita GDP growth rate between 2002 and 2007 as measured in 2000 US Dollars. This time period was chosen to smooth any fluctuations and to give time between the last openings of the sample in 1999 and the start of the growth period in 2002. The time spacing was necessary as there may be a lag between the time a market opens and increases in financial activity will extend over to economic growth.

Using two variables—*Stock.Dummy* and *Years.Open*—I am able to estimate the impact of opening a stock market on growth. *Stock.Dummy* is a dummy variable equal to one if a stock market is present and zero if not. This simplistic measure is able to test the simple question of whether the existence of a stock market accelerates growth. It is necessary to include countries that do not currently have a stock market as a control group. There are 59 countries identified that have opened a stock market between 1960 and 2000. 36 countries that do not currently have a stock market have been included as a control group, for a total of 95 countries as shown in Table 2.1. Because of limitations on data, the total sample has been reduced to 82 countries.

Although the simplistic dummy variable should be enough to assess whether the presence of a stock market causes a permanent increase in growth, there is likely a lag between the time a stock market is opened and growth is impacted. *Years.Open* is a measure counting the number of years the stock market has been open in 2010. Countries without a stock market have a value of zero. In this way, we place a higher weight on stock markets that have been open longer. Of the countries with a stock market, the lowest number of years open is 11 since the cutoff for inclusion of opening a stock market was the year 2000. The implicit assumption is that the longer a stock market has been open, the more of an impact it is able to have as funds get channeled through the real economy. The longer the market has been open, the more time it has had to cause a permanent shift. If the existence of a stock market influences growth, positively or negatively, one of these two variables should play a significant role in the regressions.

The existing growth literature has discovered a large number of variables with significant effects on growth. These were then narrowed by selecting the variables with the widest availability across countries and highest reliability, resulting in 30 control variables. Variables used in this model are closely related to those used in the growth literature, but may be specified slightly differently. Variable descriptions are shown in Table 2.2 and take into account such issues as property rights, human capital, infrastructure, and monetary assets and flows.

As with any econometric exercise, there is always room for debate about whether the correct variables were used; it is possible there are considerations that influence growth that could have been excluded. Some specific variables that have been suggested are other aspects of stock or bond markets. There are a number of measures of financial

development that would have been able to be used, but many of these could have masked the effects of stock markets. Specifically, aggregated measures of financial development, such as private credit/GDP or Liquid Liabilities/GDP are influenced by stock markets and would be inappropriate for use because of the possibility of masking the effects of stock markets. It was also decided not to use any of a number of metrics on bond markets because of the purpose of this study being to evaluate the impact of opening a stock market. While tempting to use variables related to stock market development (liquidity or stock market capitalization), the choice was made to exclude these as they would detract from the purpose of defining the contribution of opening a stock market. If the existence of a stock market is what is important, as argued by Beck and Levine (2002), the opening of a stock market should be accompanied by subsequently higher levels of growth.

2.7. Results

2.7.1. EBA Results

The combinations of free and doubtful variables have been broken into: a social/political set where these social and political effects can be captured as free variables; a financial set that sets the financial variables as free with the others as doubtful; and one with both the stock market dummy and years open set as free with the others set as doubtful. The reason for running multiple EBA estimates is to check for robustness and to address the possibility of not including adequate variables. In our search for the value of a particular parameter, we first wish to know the direction of correlation. If it is possible to generate both positive and negative coefficients, doubt

arises as to the value generated. The free variables whose bounds do not cover zero are robust in that the coefficient will always have the same sign regardless of how the model is specified.

The EBA model uses all 32 of the independent variables as discussed in the above section and summarized in Table 2.3. Where there is not an entry in the table the variable was set as doubtful, while each value reported is set as a free variable. Those variables that are robust and do not cover zero have bolded results in the table. These variables include: GDP in 1992, life expectancy, rural population, government effectiveness, export index, expected levels of schooling, and the Human Development Index. To development scholars, the fact that these variables are robust should not be a surprise. What may be surprising to some is the direction of these coefficients. *Life.Expect* and *Exp.School* are both negatively robust; indicating that as schooling and life span increase, growth is expected to decrease. Additionally, percentage of population living in rural areas (*Rural.Pop*) carries a positive value, indicating that highly urbanized countries have lower growth rates.

One interpretation behind these results is that controlling for the level of HDI, the negative coefficients attached to education and life expectancy could indicate an unbalanced HDI. For example, if HDI remains constant and education levels were to rise, life expectancy would necessarily drop. In economies with unbalanced HDIs one indicator would be significantly larger than the others. When a scenario where education is outstanding, but with lackluster per capita income and life expectancy, the economy would be unable to leverage the higher levels of education and face bottlenecks from the elements with low levels. These human development factors are a rapidly emerging field

of study and with more data availability in the future, research could further address and quantify the discrepancies between human development and growth.

Outside the explanation given by the individual factors of HDI being included in the same models, there is the possibility of poorer countries "catching up." This would provide support for convergence as theorized by Solow (1956) and supported by Barro and Sala-i-Martin (1992). These theories posit that poorer countries will have faster growth rates because they have the ability to use production techniques pioneered in the developed world and that diminishing returns to capital and labor are not as strong as they are in rich countries. The coefficients attached to education, life expectancy, and rural population are characteristics of poor countries and can be attributed to this catching up factor.

Each of the models shows that while the bounds may vary, they will always cover zero. Although fragile, the maximum likelihood estimate for both is negative, indicating a weak result that opening a stock market is associated with lower levels of economic growth. This is especially evident in Model 2 as the positive values are only generated far into the tail. Knowing that these variables can generate a coefficient in any direction warrants a fuller investigation into their effect on growth; Bayesian Model Averaging is able to quantify the impact.

2.7.2. BMA Results

The 32 explanatory variables included in this model can yield 2^{32} (4,294,967,296) total models. Even having the "right" dataset may not yield an accurate model due to the vast possibilities for model selection. It is for this reason that many

economists are unsure of other economists' results and why procedures such as BMA have arisen. The model presented in this paper attempts to objectively quantify the elements important in accelerating growth. The results of BMA return the top 73 models narrowed by leaps and bounds; Table 2.4 displays the top five models. The p!=0 column is the posterior probability of that variable being included in the model, EV is the BMA posterior mean, and SD is the posterior standard deviation of each variable. The values for R^2, BIC, and the posterior probability for each model being the best model are shown on the bottom of Table 2.4. The higher the posterior probability, the higher the likelihood the impact of the variables is not zero. The coefficients on each model can vary widely, and therein lies the averaging portion of BMA; the expected value of the mean (EV) is computed by a weighted average of each coefficient and the posterior probability when the variable enters into a model. When a variable carries a posterior probability of zero, this indicates that it was not included in any of the models and is not statistically different from zero. Therefore, their expected value is equal to zero, having no impact on growth.

Figure 2.2 shows selected variables' posterior distributions. The vertical black line at zero is the probability of the variable not being in a model with the curve being the coefficient's model averaged posterior density given that the variable is included in a model. This curve has been scaled such that the height is the probability of being included in a model; the heights of both the model averaged posterior density and posterior probability will equal one. The plots without a vertical black line are those considered to be included in a model 100% of the time according to posterior probabilities. Charting this output of the BMA posterior distribution provides slightly more information than the summary and offers another way of viewing the results. What

should be immediately noticed is that both stock market variables have large spikes at 0.0, indicating that these variables are not included in any of the models and are not statistically different from zero. On the other hand, there are a number of variables that show posterior distributions that are significantly taller than the spike indicating that their likelihood of being included is greater than being excluded.

Another feature of the BMA statistical package in R is the ability to produce an image plot as shown in Figure 2.3. This output is easier to understand for those not familiar with the procedure. Variables are listed on the vertical axis with the rankings of the models along the horizontal axis. The variables selected are shown in their rows by being either red or blue. Red indicates a positive influence while blue indicates a negative correlation. Variables included in a particular model (1–73) are highlighted in either red or blue while those not included are not highlighted. The width of the column is proportionate to its posterior probability for each model; higher ranking models have higher posterior probabilities and wider columns. The total width of all columns is equal to the cumulative posterior probability as reported in Table 2.4. The image plot (Figure 2.3) is quite influential in showing which variables are important indicators due to the abundance of color associated with these variables. The variables with high posterior probabilities—*GDP.1992, Avg.Infl, Life.Exp, RQ, nrbloan, Exp.Index, Exp.School* and *HDI*—appear prolifically in the image plot with signs consistent with theory. The exceptions are *Exp.School* and *Life.Exp* for the reasons discussed above.

Comparing the EBA results to BMA is a two-stage process in verifying the importance of certain variables. If a variable has bounds that do not cover zero and high posterior probabilities, it can be concluded that it is an important indicator without

ambiguity as to the direction of correlation. This dataset has four variables that are robust with high posterior probabilities; these are *Exp.Index, HDI, Exp.School,* and *Life.Exp*. Each of these variables is robust as measured by EBA and important as indicated in BMA.

Exp.Index is an index of exports with the base year set at 100. Countries that have imported more than they exported have a value less than 100, while countries with a trade surplus have values greater than 100. *Exp.Index* has a posterior probability of 100, is included in every model, and has a positive correlation with an expected value of .043. As confirmed by EBA, this variable is robust in that it does not cover zero and is an extremely important indicator of growth in my sample of countries. This provides the expected result that countries with higher levels of exports will tend to grow faster.

The Human Development Index (*HDI*) is a composite statistic of life expectancy, education, and income computed by the United Nations Development Programme. This variable has a posterior probability of 100.0 and carried the largest coefficient with an expected value (EV) of 25.68 and Maximum Likelihood (from EBA) of 32.443. The size of the coefficient is indicative of the weight this variable holds, the other part being due to the small size of the *HDI* variables (between 0 and 1). Two other variables deemed important are *Exp.School* and *Life.Expect*, which are used in the computation of *HDI*. *Exp.School* is a measure of the expected years of schooling. This variable proxies for human capital as the assumption is that higher levels of education lead to a more productive workforce and higher rates of growth. Importantly, the posterior probability is 64.5 with an expected value of -0.347, and this variable was found to be robust by EBA. This negative coefficient lies in contrast to our expected result. The most logical

explanation is in regards to the collinear aspects as described above. The same negative relationship is observed between *Life.Expect* and growth. *Life.Expect* is the life expectancy at birth in number of years. It would be expected that this variable would have a positive effect on growth due to this variable being a component of human capital. A healthier society should be more productive over the long run as there is less time spent away from work because of personal illness or an illness of a family member. The posterior probability of being included is 83.3 with an EV of -0.16 and a robust Maximum Likelihood -0.1995.

Because *Life.Expect, Exp.School,* and *HDI* are highly collinear, it is challenging to derive individual conclusions on these variables. Possible explanations discussed above regarding the directions of correlation are that an unbalanced HDI results in slower growth or that the poorer countries with lower values on the individual components are "catching up." One question that arises is how BMA handles multicollinearity issues. The collinearity is handled in the model because they are not perfectly collinear and by the fact that multicollinearity does not reduce the predictive power of the model as a whole. Multicollinearity only affects calculations of individual variables as it may not give valid individual results. However, when the collinear variables are bundled together, the aggregate effects estimate is reliable and adequate for my purposes. Since I am not attempting to quantify the individual effects, the best way to deal with this multicollinearity issue is to leave the model as is.

GDP.1992 captures the absolute level of GDP in 1992 and exhibits a posterior probability of inclusion at 18.6. This variable captures the size of the economy, and since it does not measure the number of people, does not incorporate relative richness. With an

expected value of 1.166e-11, it has an extremely small coefficient due to scaling as GDP is measured in billions. With a standard deviation of 1.018e-11, the majority of this variable's distribution is robust; it is only in one tail that it becomes negative. Because of the small size of the coefficient, EBA was unable to give bounds on this variable, but when combining the methodologies, absolute size of GDP is an important determinant of per capita GDP growth.

GE and *Rural.Pop* are special cases: they have robust values as shown by EBA but are not important as shown by BMA. Just knowing that a particular variable is not fragile does not necessarily mean that it has much of an impact, as shown for these two variables. These variables, for the subsets of free/doubtful combinations, were not fragile. However, that these variables did not show high posterior probabilities is indicative that these variables are not an element of the top models. The most plausible explanation for this phenomenon is that these variables are reacting with other variables, where the results are skewed. Variables need to be able to pass both methodologies in order to be certain of the direction of correlation and that the impact differs from zero.

Avg.Infl, nrbloan and *offdep* had fragile extreme bounds, but were shown to be important by the BMA methodology. Inflation's (*Avg.Infl*) impact on growth has been well documented in the literature. My results show that it is important (posterior probability equal to 71.8) and most likely has a positive correlation (EV of .02 and a SD of .015), meaning that higher levels of inflation indicate higher levels of growth.[1] Non-resident bank loans (*nrbloan*) was also fragile, carrying a negative coefficient (-0.229),

[1] This is an interesting result as this relationship is surely not linear, nor always positive. One explanation behind this result could be that it is an artifact of the time period examined where there was a high level of relative stability with only three outliers—Angola, Democratic Republic of the Congo and Liberia—experiencing extremely high inflation (above 200% annually). Angola was actually one of the faster growing in the sample with an average growth rate of 14.1% and average inflation of 222.3%.

yet was included in 31.5% of the narrowed models. This result implies that higher levels of offshore bank loans to GDP correlate with lower levels of per capita growth. The offshore deposits to domestic deposits ratio (*offdep)* follows the same traits with a posterior probability of 40.3, yet has a standard deviation that covers zero (EV of -0.033 and a SD of 0.044). These three variables appear important but offer low levels of certainty as to their sign because the extreme bounds cover zero.

RQ, regulatory quality index computed by the World Bank Governance Indicators, has fragile extreme bounds but entered into the BMA output as reasonably important with a posterior probability of 29.5. The expected value coefficient for *RQ* is -0.519, yet it has a standard deviation of 0.88. This places a significant portion of the coefficient distribution on the other side of zero, effectively questioning its robustness. The less stringent checks for robustness as provided by BMA are able to question, and probably discard, this variable as an important determinant of growth. Rule of Law, *RL*, was another variable that did not pass the weaker robustness check in BMA but is of less concern because its posterior probability of 10.0 barely registers.

The most interesting thing to note, and the focus of this paper, is that the variables *Years.Open* and *Stock.Dummy* show a posterior probability of being included at exactly zero—meaning that neither of these variables is important in explaining growth. Other financial and social considerations appear to be more important in understanding growth. This means that both measures of stock markets do not display any explanatory power and, therefore, cannot be concluded to be an important indicator of growth. The reliability of this methodology in predicting growth is rather high, reporting R^2 in excess of 0.5 on

the individual models. This fit is in keeping with much of the results in the existing growth literature.

2.8. Conclusion

In light of the large body of literature that has arisen as to the benefits of financial development on growth, this paper empirically evaluates the relationship between opening a stock market and growth. Basic economic theory posits that effective, functioning financial markets will lead to more projects to be funded and fuel economic growth. However, a small number of theorists believe that the rapid expansion of financial services may not be the gateway it was hoped. When evaluating whether a stock market is beneficial, the benefits must be weighed against the costs. The first argument questioning the effectiveness of stock markets is that active stock markets can lead to instability, causing a drag on long run economic growth. The second argument that carries merit is that developing countries are unable to fully leverage the benefits to be gained from an active stock market, so they will have little to gain from one opening. It is this second argument that I have argued is the limit to the effectiveness of opening a stock market.

In formally testing my hypothesis that stock markets are irrelevant for growth, I use two Bayesian econometric methods: Extreme Bounds Analysis and Bayesian Model Averaging. EBA is a global sensitivity analysis able to compute the extreme bounds with which a variable is able to take. EBA results show that the opening of a stock market, and the number of years that market has operated have fragile and nonrobust effects on economic growth. Bayesian Model Averaging has the ability to objectively take a dataset

and determine the probabilities with which variables are different from zero by averaging over a reasonable subset of possible models. Both the stock market variables exhibited posterior probabilities of being included in the models with the best fit of 0.0, showing that the simple act of opening a stock market is not indicative of growth (in either direction) in this sample of countries. The results from this study provide significant evidence that opening a stock market has little, if any, influence on growth.

While there are certainly cases where stock markets can be beneficial to an economy, there is insufficient evidence that stock markets on the whole are able to promote growth. That some countries may be able to better leverage the use of a stock market deserves more attention in the literature. Individual characteristics of the instances where stock markets deliver societal benefits are likely the most important determinant of whether a stock market will influence growth. Further research is needed to evaluate the specific conditions where opening a stock market and other elements of financial development are beneficial for human development.

2.9. References

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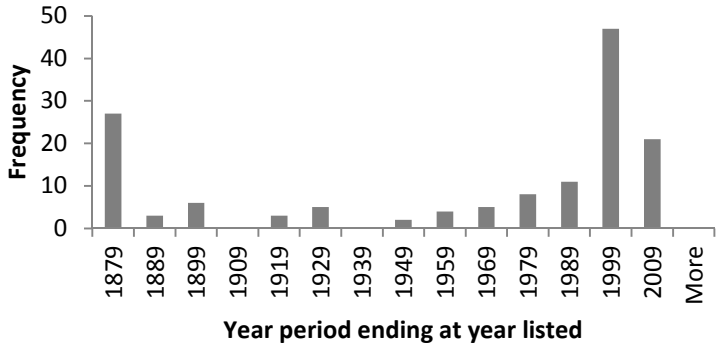

Figure 2.1 Stock Market Openings over Time

Table 2.1: Countries in Sample

Country	Year Open	Country	Year Open	Country	Year Open
Albania	1996	Fiji	N/A	Namibia	1992
Algeria	1999	Gabon	N/A	Nepal	1993
Angola	N/A	Gambia, The	N/A	Nicaragua	1990
Armenia	N/A	Georgia	1999	Niger	1998
Bahrain	1989	Ghana	1990	Nigeria	1961
Belarus	1998	Guinea	N/A	Oman*	1989
Belize	N/A	Guinea-Bissau	1998	Papua New Guinea	1999
Benin	1998	Haiti	N/A	Romania	1995
Bhutan*	1993	Honduras	1990	Russian Federation	1992
Bolivia	1990	Iceland	1986	Samoa*	N/A
Botswana	1989	Iran, Islamic Rep.	1968	Saudi Arabia*	1985
Brunei Darussalam	N/A	Jamaica	1969	Senegal	1998
Burkina Faso	1998	Jordan	1999	Seychelles*	N/A
Burundi	N/A	Kazakhstan	1993	Slovak Republic	1991
Central African	N/A	Kiribati*	N/A	Solomon Islands	N/A
Republic	N/A	Kyrgyz Republic	1995	Sudan	1995
Chad	1990	Lao PDR	N/A	Suriname	1994
China	N/A	Lesotho	N/A	Swaziland	1990
Comoros	N/A	Liberia	N/A	Tajikistan	N/A
Congo, Dem. Rep.	N/A	Lithuania	1993	Tanzania	1996
Congo, Rep.	1976	Macedonia, FYR	1995	Thailand	1975
Costa Rica	1998	Madagascar	N/A	Togo	1998
Cote d'Ivoire	1991	Malawi	1996	Tonga	N/A
Croatia	1996	Mali	1998	Trinidad and	1981
Cyprus	N/A	Malta	1992	Tobago	1969
Djibouti	N/A	Marshall Islands*	N/A	Tunisia	N/A
Dominican Republic	1970	Mauritania	N/A	Turkmenistan*	1997
Ecuador	1997	Mauritius	1989	Uganda	1991
Egypt, Arab Rep.	1965	Micronesia, Fed. Sts.*	N/A	Uzbekistan*	N/A
El Salvador	N/A	Moldova	1994	Vanuatu*	N/A
Equatorial Guinea	N/A	Mongolia*	1991	Yemen, Rep.	1993
Eritrea*	N/A	Mozambique	1999	Zambia	
Ethiopia					

*Countries not included in model due to insufficient data: total countries include is 82.

Table 2.2: Variable Descriptions

Variable Name	Description	Mean	Std Dev
Avg Growth	Dependent variable – average growth of per capita GDP from 2002-2007, expressed as percentage. 2000 constant dollars (World Bank)	4.305	4.104
Years.Open	Number of years stock market has been open. Equal to 0 if no stock market	12.93	12.3
Stock.Dummy	Dummy equal to 1 if country has stock market, 0 otherwise	n/a	n/a
Low.Mid	Dummy variable equal to 1 if lower middle quartile country, 0 otherwise (as defined by the World Bank)	n/a	n/a
Upper.Mid	Dummy variable equal to 1 if upper middle quartile country, 0 otherwise (as defined by the World Bank)	n/a	n/a
Low.Income	Dummy variable equal to 1 if lowest income quartile country, 0 otherwise (as defined by the World Bank)	n/a	n/a
Per.Cap.GDP	Per capita GDP in 1992, 2000 constant dollars (World Bank)	1946.3	3785.79
GDP.1992	Absolute level of GDP in 1992, 2000 constant dollars (World Bank)	19.2 bil	70.54 bil
Avg.Infl	Average Inflation for period 1997-2002, expressed as percentage (World Bank)	24.54	79.25
Tax.Rate	Total amount of taxes payable by businesses after accounting for deductions and exemptions as a percentage of profits, 2007 – chosen for completeness of data. (World Bank)	57.36	54.76
FDI.Flow	Absolute value of foreign direct investment flows (UNCTAD)	1082.62	5415.99
Paved.Road	Percent of roads in country that are paved, average from 1995 - 2005 (World Bank)	37.99	29.93
Adj.Savings	Adjusted gross savings – difference between Gross National Income and public and private consumption, 2002 (World Bank)	16.55	14.34
Ag.Land	Percent of land area dedicated to agricultural produce, 2002 (World Bank)	41.53	22.45
Ag.Value.Added	Total amount of agricultural value added per worker, constant 2000 dollar (World Bank)	3082.25	9314.6
Life.Expect	Life Expectancy at birth in years, 2002 (UNESCO)	62	10.46
Pop.Growth	Average population growth 1997-2002 expressed as a percentage (UNESCO)	1.64	1.21
Cell.Phone	Number of cell phones per 100 people, 2002 (World Bank)	12.44	18.02
Curr.Acct	Current account balance, BOP, 2002 (World Bank)	0.62	5.23
Rural.Pop	Rural Population as percent of total population, 2002 (World Bank)	54.87	20.6
CC	Control and Corruption Index, 2002 (World Governance Indicators, World Bank)	-0.48	0.67
RL	Rule of Law Index, 2002 (World Governance Indicators, World Bank)	-0.5	0.73
RQ	Regulatory Quality, 2002 (World Governance Indicators, World Bank)	-0.39	0.74
GE	Government Effectiveness, 2002 (World Governance Indicators, World Bank)	-0.45	0.72
VA	Voice and Accountability, 2002 (World Governance Indicators, World Bank)	-0.41	0.79
Nrbloan	Offshore bank loans relative to GDP, 2002 (BIS Statistical Index via Demirguc-Kunt and Levine, 2009)	0.49	2.99
Exp.Index	Export index with 2000 as base year set at 100, 2000 (UNCTAD)	107.95	27.92
Exp.School	Expected years of schooling at birth (UNDP Human Development Index Report)	10.66	3.05
Fertility	Total fertility rate (births per woman), 2002 (UNESCO)	3.8	1.78
HDI	Human Development Index, 2000 (UNDP Human Development Index Report)	0.55	0.17
Dbacba	Deposit money bank assets / (deposit money + central bank) assets, 2002 (IMF International financial statistics via Demirguc-Kunt and Levine, 2009)	0.75	0.24
Bcbd	Private credit by deposit money banks as a share of demand, time and saving deposits in deposit money banks, 2002 (IMF International financial statistics via Demirguc-Kunt and Levine, 2009)	0.81	0.49
offdep	Offshore bank deposits relative to domestic deposits, 2002 (BIS Statistical Index via Demirguc-Kunt and Levine, 2009)	3.64	28.75

Table 2.3: EBA Results

Variable Name	Maximum Likelihood Point Estimate	Model 1 Low	Model 1 High	Model 2 Low	Model 2 High	Model 3 Low	Model 3 High
Constant (Int)	2.1857	-29.308	28.4340	-7.6931	9.3720	-38.4143	44.3200
Years.Open	-0.0125	-0.099	0.0780	-0.0692	0.0728	-0.1827	0.1961
Stock.Dummy	-0.6104	-2.467	1.8001	-1.8219	0.5597	-3.8707	3.6396
Low.Mid	-3.0917						
Upper.Mid	-2.6088						
Low.Income	-2.5896						
Per.Cap.GDP	0.0000						
GDP.1992[2]	0.0000						
Avg.Infl	0.0283						
Tax.Rate	-0.0038						
FDI.Flow	0.0000	-0.00051	0.00038				
Paved.Road	0.0086			-0.0074	0.0408		
Adj.Savings	-0.0450	-0.08878	0.08054				
Ag.Land	0.0135						
Ag.Value.Added	-0.0001						
Life.Expect	**-0.1995**			**-0.0729**	**-0.3587**		
Pop.Growth	0.6186			-0.6322	1.1535		
Cell.Phone	-0.0296			-0.1075	0.0695		
Curr.Acct	-0.1970	-0.94909	0.13024	-0.7776	0.5806		
Rural.Pop	**0.0341**			**0.0011**	**0.0654**		
CC	-0.4090			-2.1138	1.7308		
RL	-0.8849	-5.9948	4.412	-2.4408	0.2125		
RQ	-0.8106			-2.9101	0.0887		
GE*	**1.9580**			**0.1727**	**3.9121**		
VA	-0.5770			-1.4836	0.6655		
Nrbloan	-0.6539	-3.8377	3.8902	-3.4009	2.7470		
Exp.Index	**0.0520**	**0.01331**	**0.0844**	**0.0267**	**0.0680**		
Exp.School	**-0.5328**			**-0.9953**	**-0.1850**		
Fertility	-0.7244			-1.1120	0.4108		
HDI	**32.4433**			**11.7857**	**54.1040**		
Dbacba	-2.1391	-5.2162	3.3638				
Bcbd	1.1509	-0.7079	2.6319				
offdep	-0.0106	-0.4708	0.0364				

Bolded values are robust, not covering zero.

[2] Rounding to only four decimal places generates a 0.0000 Maximum Likelihood estimate. The current EBA code is unable to give the exact bounds, but appears as though they cover zero

Table 2.4: BMA Summary Output

73 models were selected. Best 5 models (cumulative posterior probability = 0.1767):

	p!=0	EV	SD	model 1	model 2	model 3	model 4	model 5
Intercept	100.0	-1.463e+00	4.225e+00	5.833e-01	2.477e+00	-1.157e+00	3.753e-01	-2.579e-01
Years.Open	0.0	0.000e+00	0.000e+00	.	.	.	.	.
Stock.Dummy	0.0	0.000e+00	0.000e+00	.	.	.	.	.
Low.Mid	0.0	0.000e+00	0.000e+00	.	.	.	.	.
Upper.Mid	0.0	0.000e+00	0.000e+00	.	.	.	.	.
Low.Income	0.3	4.632e-03	1.080e-01	.	.	.	.	.
per.cap.GDP	21.1	-5.490e-05	1.180e-04	.	.	-2.808e-04	.	-2.702e-04
GDP.1992	18.6	2.275e-12	5.234e-12	.	.	.	1.197e-11	.
Avg.Infl	71.8	2.017e-02	1.507e-02	.	.	3.028e-02	.	2.976e-02
Tax.Rate	0.0	0.000e+00	0.000e+00	.	.	.	.	.
FDI.Flow	78.4	1.365e-04	9.202e-05	1.657e-04	1.693e-04	1.749e-04	.	1.663e-04
Paved.road	22.1	6.308e-03	1.373e-02	.	2.956e-02	.	.	.
Adj.Savings	19.7	-1.062e-02	2.504e-02	.	.	.	.	.
Ag.Land	0.0	0.000e+00	0.000e+00	.	.	.	.	.
Ag.Value.Added	16.7	-1.464e-05	3.674e-05	.	.	.	.	.
Life.Expect	83.3	-1.626e-01	1.027e-01	-2.276e-01	-2.473e-01	-1.569e-01	-2.172e-01	-1.629e-01
Pop.Growth	0.0	0.000e+00	0.000e+00	.	.	.	.	.
Cell.Phone	12.9	-8.133e-03	2.334e-02	.	.	.	.	.
Curr.Acct	0.0	0.000e+00	0.000e+00	.	.	.	.	.
Rural.Pop	4.4	1.759e-03	9.491e-03	.	.	.	.	.
CC	4.3	-6.466e-02	3.323e-01	.	.	.	.	.
RL	10.0	-1.604e-01	5.256e-01	.	.	.	.	.
RQ	29.5	-5.186e-01	8.766e-01	-1.938e+00	-1.835e+00	.	-1.860e+00	.
GE	0.0	0.000e+00	0.000e+00	.	.	.	.	.
VA	10.0	-1.172e-01	3.920e-01	.	.	.	.	.
nrbloan	31.5	-2.286e-01	3.661e-01	.	.	.	.	.
Exp.Index	100.0	4.332e-02	1.306e-02	4.189e-02	3.905e-02	3.935e-02	4.348e-02	4.051e-02
Exp.School	64.5	-3.477e-01	3.210e-01	-5.769e-01	-6.250e-01	.	-6.098e-01	-4.448e-01
Fertility	0.0	0.000e+00	0.000e+00	.	.	.	.	.
HDI	100.0	2.568e+01	1.006e+01	3.364e+01	3.193e+01	1.974e+01	3.313e+01	2.711e+01
dbacba	0.0	0.000e+00	0.000e+00	.	.	.	.	.
bcbd	1.4	1.397e-02	1.455e-01	.	.	.	.	.
offdep	40.3	-3.286e-02	4.371e-02	.	.	-8.733e-02	.	-7.810e-02

nVar	6	7	7	6	8
r2	0.465	0.492	0.489	0.459	0.513
BIC	-2.485e+01	-2.471e+01	-2.419e+01	-2.392e+01	-2.376e+01
post prob	0.046	0.043	0.033	0.029	0.027

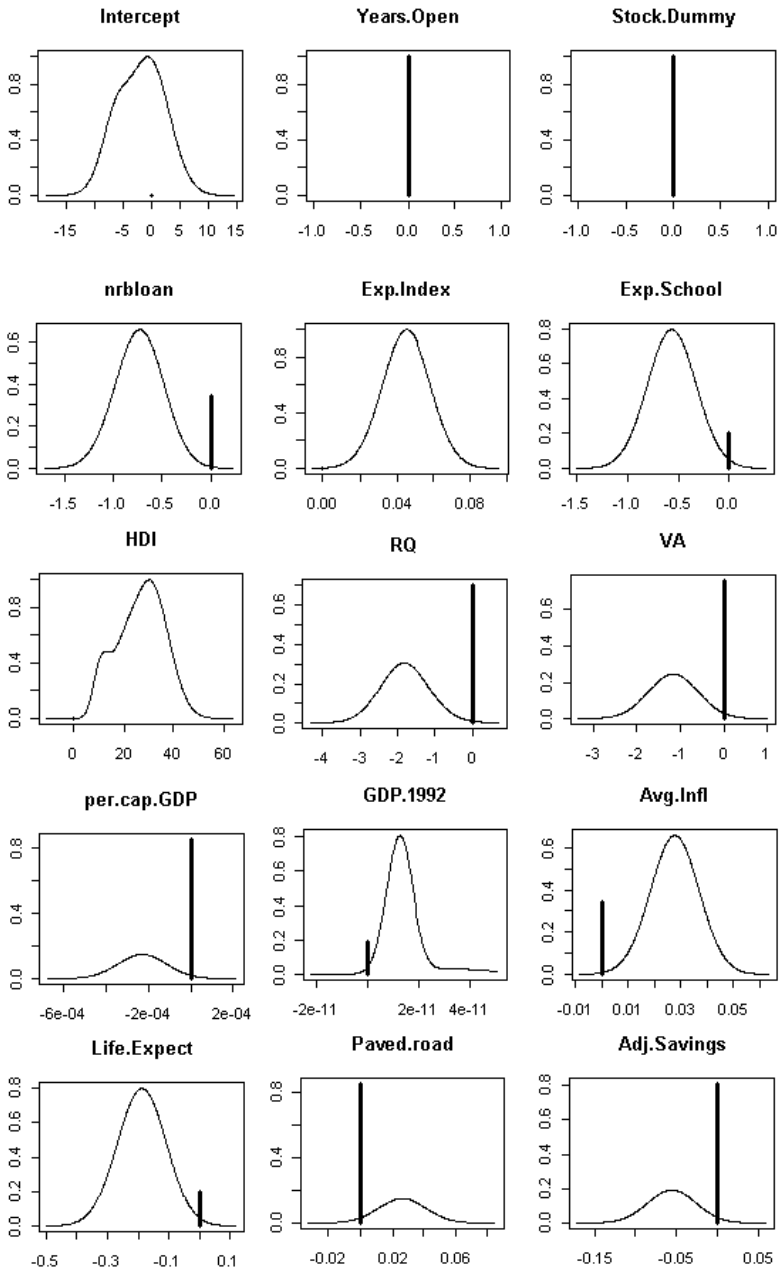

Figure 2.2: Selected Posterior Distributions

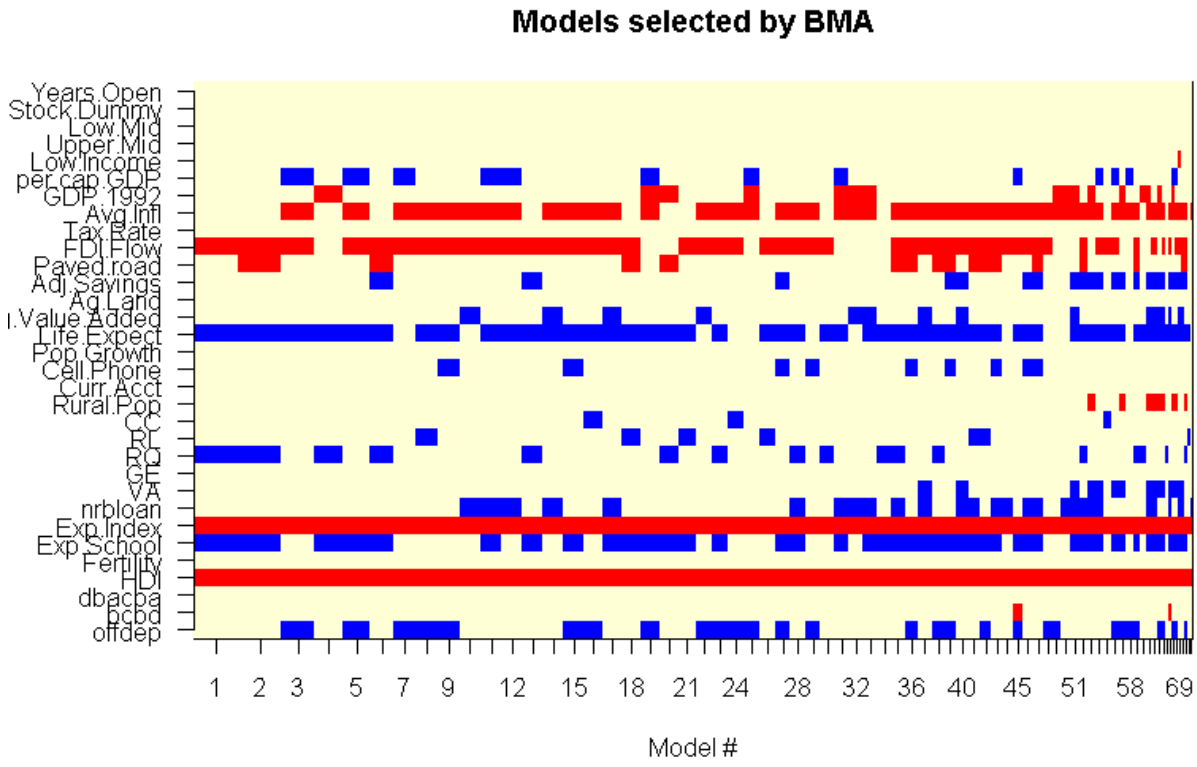

Figure 2.3: BMA Image Plot

CHAPTER 3

SCHUMPETERIAN INNOVATION AND EQUITY ISSUANCE

3.1. Abstract

I hypothesize that highly innovative firms—those with high risk, yet higher potential return—will be more likely to raise funds through stock markets than bond issuance. Using the Schumpeterian innovation life-cycle as a theoretical framework, I argue that that in the beginning, firms with radically new innovations are more likely to raise funds through equity issuance until it becomes an acceptable loan for bankers with a limited return (interest rate). This is all placed within the context of, and does not conflict with, the dominant theories of firms' capital structure: the Trade-Off, market timing, and Pecking Order Models.

Empirically, I test this relationship of innovative activity to equity issuance by using patents as a proxy for innovation from a dataset covering 1970 to 1992, encompassing 25,064 instances where firms raised funds through either the bond or stock market. This independent variable is then regressed on the ratio of funds raised through equity to total funds raised. I find statistically significant evidence using a dichotomous, probit model that the industries with higher innovative/patenting activities are

significantly more likely to raise funds through stock market issuance than firms without innovative activity.

3.2. Introduction

Do firms care about their capital structure? Do investors? With the introduction of the Modigliani and Miller (1958) Irrelevance Proposition, it was argued that in perfect capital markets, firms will be indifferent to their capital structure. Competing theories of capital structure emerged in light of the restrictive assumptions imposed by Modigliani-Miller and the difficulties in empirically testing this idea. One aspect of capital structure literature that does receive attention from any of the dominant theories is that firms have different capital requirements over their life cycle. These financing requirements and constraints will influence whether firms will raise capital through debt or equity.

I hypothesize that firms' external capital decisions change depending upon where they fall within the innovation life cycle as conceptualized by Joseph Schumpeter in *Capitalism, Socialism, and Democracy* (Schumpeter, 1942). I argue that in the beginning of the life cycle, firms that are highly innovative will be more likely to raise funds through the stock market than mature firms that are further into the life cycle. This is based around the argument that banks ration credit, limiting the amount of funds to newer industries with higher levels or risk, even though there is a high potential return. Even in the presence of a high risk premium, banks have asymmetric returns as they are exposed to losing their entire investment in the event of default while returns are limited to a fixed interest rate.

Along the innovation life cycle, the industries emerging are classified as being radically innovative because they products or processes they are promoting are radical departures from those currently seen. This period is marked by large amounts of innovation, which steadily decreases as the industry reaches stagnation. Innovations tend to be clustered in the beginning of the innovation life cycle (Keklik, 2003). Competition intensifies as the product makes it to market, causing less innovative firms to drop out. After the weaker firms fall, successful firms become more attractive for debt financing. During the time when there is a large amount of competition to "produce or perish," radically innovative firms have large capital requirements and do not have access to the same financial instruments that mature firms traditionally use. The supply constraints imposed by lenders does not reduce these firms' requirements for capital. They will continue to seek capital and will have a larger portion of equity to debt in their capital structure. I posit that stock market issuance is used more by firms during the early stages of the life cycle because of constraints on their ability to use debt.

My theory as to choices made by radically innovative firms does come into conflict with any of the dominant theories of capital structure—Trade-Off, Pecking Order, and market timing. The Trade-Off theory (Kraus and Litzenberger, 1973) posits that firms will balance the tax advantages of debt with the increased probabilities of bankruptcy as they become more leveraged; it is postulated that there is an optimal level of leverage that maximizes the firm's value, and taking on more debt than the optimal will result in a lower valuation. My theory states that radically innovative industries are more likely to default and will result in a lower optimal level of leverage. If the firms still have additional capital requirements above the optimal leverage ratio, they will raise

all additional funds through equity/stock markets. Myers and Majluf (1984) introduce the Pecking Order theory as the main competitor to the Trade-Off theory. Rather than concerns over balancing costs and benefits, Myers and Majluf introduce asymmetric information, positing that investors believe firms' managers hold more information and would not be issuing stock unless they believe it to be overvalued. Because of the information problem (perceived or otherwise), Myers (1984) hypothesizes that adverse selection will occur, resulting in investors discounting the stock offering. Because of the discount placed on equity, stock market financing is only used as a last resort by firms unable to raise capital from any other source. Being constrained by debt markets, radically innovative firms are then more likely to need to use stock markets for capital because of the lack of options.

I am able to empirically show how firms in innovative industries have a higher likelihood of raising funds through the stock market, controlling for portfolio returns and other market conditions. While the data do not allow for a precise positioning of firms within the life cycle, I provide empirical results in support of my theory that firms at the beginning of the innovation life cycle will be more likely to raise funds through equity than firms at the end of the life cycle. This is performed using patents as a proxy for innovation, operating on the assumption that more innovation occurs in the early stages of the life cycle. Probit estimation methods with clustered standard errors are used to estimate this relationship between innovation and firm choice as to whether debt or equity financing is used. The results are straightforward; I find significant evidence that the more innovative a firm is, the more likely it is to use the stock market to raise funds

when it is seeking external capital. These results are consistent with most of the literature on capital structure.

3.3. Theories of Capital Structure

As the first widely accepted theory of capital structure, Modigliani and Miller (1958) showed that the value of the firm is not affected by how the firm is financed. The theory is that firms will raise external capital through whichever avenue is the least expensive, bringing the most capital at the lowest cost. The implication is that it does not matter what the underlying capital structure is; whether firms raise funds through equity or debt and how they pay dividends is irrelevant to firm value. Modigliani and Miller reached this Irrelevance Proposition under some crucial assumptions: perfect capital markets in the absence of taxes, bankruptcy costs, asymmetric information, adverse selection, and agency costs. While a ground breaking piece of research, the introduction of various market imperfections has given rise to a number of competing theories as to why firms finance themselves the way they do.

3.3.1. Trade-Off Theory

The basic arguments behind which theory of capital structure is ideal are derived from disagreements over which imperfections are most important. These imperfections include agency costs, asymmetric information, bankruptcy costs, and taxes. Following is a discussion of the dominant theories of capital structure: Trade-Off, market timing, and Pecking Order. Modigliani and Miller (1963) acknowledged that the benefits gained from taxes are not insignificant, but that "under our analysis the tax advantages of debt

are the *only* permanent advantage" (Modigliani and Miller, 1963, p. 434). This is concluded by a reaffirmation of the 1958 hypothesis with the conclusion that these tax benefits are still small and, once investors' personal taxes are factored in, there are circumstances where other forms of finance may be cheaper for the firm than pure debt issuance. Empirically, Modigliani–Miller is difficult to test with many researchers unable to find reasonable evidence that it holds up using modern statistical methods (Frank & Goyal, 2007). Although it has long since been realized that perfect capital markets with perfect information do not exist, understanding Modigliani–Miller can help an understanding of how imperfections can distort markets.

Arguing that taxes are an important factor in how firms finance themselves, Kraus and Litzenberger (1973) introduced the Trade-Off Theory of capital structure. The mix of financing depends on the tax savings and the states in which a firm would become insolvent. There is significant tax advantages for firms that are gained by issuing debt that far outweigh any of the costs incurred by investors' personal taxes. Paying interest on outstanding debt is tax deductible and lowers the cost to service the debt. On the dark side of leverage, Kraus and Litzenberger introduce bankruptcy costs into consideration. Modigliani and Miller (1958) assumed that firm value does not depend on how certain they are to repay their debt obligations; the value of a firm is not affected by its leverage since bankruptcy penalties do not exist in perfect capital markets. However, under the Trade-Off theory, as the leverage ratio increases, the value of a firm begins to fall because of the increased probability of becoming insolvent.

The basic Trade-Off models predicted much higher debt levels than were actually observed (Miller, 1977). This is addressed by the discussion of whether firms are able to

costlessly restructure their debt at any given time. Kane, Marcus, and McDonald (1984) and Brennan and Schwartz (1984) separately developed continuous time models incorporating the imperfections of uncertainty, taxes, and bankruptcy costs, but ignoring transactions costs. Modeling uncertainty reduced the optimal leverage ratio, but still predicted values that were much larger than were actually observed. These models were still unable to explain the stickiness of restructuring their leverage ratio. Introducing transactions costs, Fischer, Heinkel, and Zechner (1989) found that even in the presence of small transactions costs, firms allow their leverage ratio to "float" within certain bounds, only adjusting when the ratio moves outside those bounds. That small transaction costs will lead to stickiness in adjustments of the leverage ratio makes it more difficult for smaller, less liquid firms to raise capital through the market. Investors purchasing a firms' bonds or stocks in the market from an illiquid company will face greater transactions costs, thus reducing the desire to purchase these securities. Discussions surrounding whether the Trade-Off theory can predict leverage ratios, and whether firms attempt to reach them, are relevant as a test of predictive power.

Henessey and Whited (2005) and Strebulaev (2007) dispute that firms are underlevered relative to the predictions of the Trade-Off theory. These results present new estimates of the bankruptcy costs and tax benefits, providing leverage ratios that are consistent with current corporate debt levels. Other considerations have arisen out of the behavioral finance literature around confidence levels of company managers. Hackbarth (2008) presented a theoretical model, concluding that overconfident managers will raise more debt, carrying a higher leverage ratio. This is backed by Malmandier and Tate (2005) using a survey of CEOs of public companies, finding that the CEOs who were

overconfident tended to raise more funds from debt relative to equity and had higher leverage ratios. Essentially, the overconfident managers discounted their bankruptcy costs and carried more leverage. While Malmandier and Tate were unable to assess the magnitude of the effect, these behavioral models have definitively shown there are a number of different elements behind why certain firms select equity or debt. Within all the Trade-Off models, the idea still holds that the optimal leverage ratio is the point with which tax benefits are maximized subject to bankruptcy costs, although changing assumptions can alter where the optimal leverage point is.

An illustrative, stylized model of the Trade-Off theory is shown in Figure 3.1. The total value of the firm on the vertical axis is plotted against the leverage ratio, Debt to Assets (D/A) on the horizontal axis. The intercept, $\hat{V}$, is the value of a firm with no leverage and funded purely by equity or retained earnings. When a firm is at this point, they are not maximizing the value of the firm as borrowing would allow the firm to pursue additional profit opportunities. FV_{nd}, *nd* subscript indicating "no default," shows what a firm's value would be in the absence of any costs associated with increased leverage. With no chance of default, a firm could theoretically borrow unlimited funds, invest them, and watch the value of the firm grow. The flip side of the leverage is that while leverage can multiply profit rates, it can also multiply losses. The more leverage a firm maintains, the higher the probability a shock or poor investment will leave the firm insolvent.

FV' is the firm value that incorporates bankruptcy costs and additional borrowing costs imposed by lenders to cover a higher risk of default. Eventually, there becomes a point where the costs of increased leverage would outweigh the benefits, causing the

firm's value to drop. FV' would be close in value with FV_{nd} up until a point, D/A', because at low levels of leverage, the probability of default is negligible. Firms, as profit maximizing entities, will attempt to maximize their value and select the optimal leverage ratio at D/A^* where the marginal benefits of debt equal the marginal costs of bankruptcy. At leverage levels between D/A' and D/A^*, the costs of leverage are nonnegligible, but increasing at an increasing rate. Until D/A^* is reached, the benefits still exceed the costs; at leverage levels greater than D/A^*, bankruptcy costs exceed the tax benefits. If a firm has additional profitable opportunities and is in need of more capital than it would receive at the optimal leverage ratio, the firm would then turn to equity markets. The Trade-Off theory maintains that firms will reach their optimal leverage ratio in order to maximize their value. The only circumstances where they would raise equity is if capital in excess of the optimal level was needed.

3.3.2. Market Timing

As a descendant of the Modigliani-Miller irrelevance proposition in that firms seek external capital through the least expensive method, Baker and Wurgler (2002) formalized a theory of market timing. While there may be costs associated with whichever form of capital is used, firms are essentially indifferent to their capital structure and will raise external capital through whichever avenue offers the lowest cost to the firm. These costs change over time with firms using whatever carries to lowest cost to the firm. This differs from the Modigliani-Miller assumption that market characteristics remain constant, whereas market timing theorists postulate that market fluctuations influence the decisions made by firms seeking external capital.

During bull markets, firms will be valued higher by the market and should issue more equity. In contrast, as interest rates rise, firms will be less likely to borrow because of the higher borrowing costs. There have been a number of econometric studies finding evidence of firms raising funds through the different avenues depending on market conditions (Dittmar & Dittmar, 2008; Dong, Loncarski, Horst, & Veld, 2012; Elliot, Koeter-Kant, & Warr, 2008; Lowry & Schwert, 2002). Each finds evidence that firms with overvalued equity are significantly more likely to issue equity than those that are undervalued. Current market conditions prove to be at least a minor consideration for firms when raising external capital.

3.3.3. Pecking Order

Myers (1984) contends that the Trade-Off theory suffers from the classic "horse and rabbit stew" problem. Myers argues that tax benefits of debt (horse) greatly outweigh the small probability event costs of bankruptcy (rabbit), and that the majority component of capital structure (stew) is debt. Since bankruptcy is a low probability event, Myers concludes that firms would be financed solely through debt, in contrast to what is actually observed. The Pecking Order theory of capital structure was introduced by Donaldson (1961) in response to Modiglini-Miller. This was greatly expanded by Myers and Majluf's (1984) introduction of asymmetric information, contending that firms will use funds according to a pecking order, where internal funds are the first to be depleted. Only after internal funds are exhausted will they seek external financing; the next source of funds would be debt, only using equity as a last resort. Debt is placed last in line because rational investors are aware that firm managers hold more information

than they do. Asymmetric information forces adverse selection in that a rational investor believes that firm managers will only raise funds through the stock market when they are overvalued. Outside investors must assume that the company must be overvalued or the firm would not issue equity. Therefore, the only time investors would purchase stock from the company is when it is obviously undervalued, with firms only issuing undervalued stock when there are no other options. Formal models of adverse selection and equity selection can be found in Cadsby, Frank, and Maksimovic (1990), Eckbo and Masulis (1992), Eckbo and Norli (2004), and Noe (1988).

Empirical studies such as Rajan and Servaes (1997) find that firms are more likely to issue equity when analysts have more optimism about the offering, thus having higher values and allowing firms to raise more capital. Firms traditionally attempt to present themselves in as positive manner as possible in order to persuade potential investors to purchase their offerings at the highest possible price. Myers and Majluf (1984) have argued that investors are aware of the selectivity of information release and are likely to discount the offering. Rajan and Servaes contend that it is driven by the opposite; firms will not issue equity unless investors have similar expectations about future profits and values of the IPO. In the same light, Dittmar and Thakor (2007) contribute to the stylized fact that firms issue more equity when their stock prices are high, positing that managers of companies are more likely to finance their operations through equity issuance when they believe investors' views about projected payoff are aligned with the firm. Firms are aware of information problems, attempting to avoid problems of adverse selection by making all possible information available to potential investors. Dittmar and Thakor

argue that investors are not subject to asymmetric information problems to the extent theorized by Myers and Majluf (1984), resulting in higher levels of equity issued.

As seen above, the basis of much of the discourse in the capital structure literature is based around a debate over which imperfections are most important. Within the literature, the majority has concentrated on how firms will restructure their leverage around the optimum ratio as well as the determination of the optimal leverage ratio. What none of these theories do is differentiate financing decisions according to where the firms fall within the innovation life cycle. I contend that firms have different desires and constraints on their fund raising activity depending on how innovative they are. This is shown by discussing the Schumpeterian innovation life cycle, how firms finance themselves throughout this life cycle, and how it all fits within the capital structure models.

3.4. Innovation Life Cycles in the Vein of Schumpeter

Innovations that precipitate the decline of the stagnant industries are envisioned by the concept of Creative Destruction (Schumpeter, 1942) and generate a radical shift from the existing economic system to a new and more efficient one. Schumpeter believed that the business cycle was driven by technological innovation. The introduction of new, major technological innovations alters old economic routines; the rise of new products and industries forces out stagnant firms in industries that are no longer innovating. Accordingly, firms in the early stages of the life cycle will have different capital requirements and when raising capital will do it in different ways.

Schumpeter saw competitive markets not as sending price signals for the allocation of scarce resources, but rather as forcing firms to innovate in order to capture profits. It was felt that entrepreneurs were the drivers of economic growth since in order to be successful they must bring new ideas, products, or processes to the market. Without new ideas an entrepreneur would lack any competitive advantages and, due to the substantial barriers of entry created by mature industries, would have a slim chance of success. The typically small size of the new firms erodes the power held by the mature and dominant firms, challenging and disrupting existing production routines. Unless the mature firm is able to effectively transition to a technology in a newer industry, the firm will become stagnant with eventual death. The spirit of innovation is that it is used by producers to gain or maintain market share. I define innovation as any improvement over old products, processes, or ideas. There are two basic types of innovations that are included in my definition: product and process. Product innovations are those that either introduce a new product or change it in some way while process innovations are those that make production less expensive to produce. Naturally, there are innovations that are more important than others. The innovations earlier in the life cycle are larger departures from those currently seen, while those towards the end do not have much of an impact.

Derived from Schumpeter's theory of creative destruction, Mensch (1975) expands the innovation life cycle, expanding and classifying innovations into three basic stages. In the first stage, a product is considered a radical innovation—one that radically changes a production process or changes how people live their daily lives. After a period of time these radical innovations become more accepted as the industry moves into the second "important innovation" stage. The industries in this stage face large accelerations

in output as the product is rapidly adopted by consumers. This phase has the fiercest competition as there are high numbers of firms, each making incremental improvements to the initial innovation. Firms are forced to raise large sums of funds during this time period because of the rapid expansions in output and to survive the brutal competition for survival. It is in the third stage (pseudo innovation) that substantive changes to a product cease and firms begin to lose their competitive advantages. According to Mensch, the rise of stagnant industries is what is known as a "technological stalemate," where pseudo innovations become the norm. Stagnant industries' production tapers off as radically new innovations begin to emerge, competing within the same market space. The demise of old and stagnant industries, accompanied by new innovative industries, completes the cycle of Creative Destruction.

As an illustrative example of the stages of innovation with the life cycle, we will evaluate the replacement of the traditional film camera by digital cameras. The traditional film camera was a great idea and one that had a large impact. In its infancy, at the beginning of the life cycle, the cameras were cost-prohibitive for most people to purchase and output was low. As time moved on, more and more people were purchasing the cameras, yet there was still significant innovation in the industry as new features were released. The digital camera was based off the same basic idea as the film camera, but the finished product was a radical departure from the film camera. In the early stages, before the digital camera caught on, digital and film were able to coexist. Once prices started falling for digital cameras, there was a large surge in output at the expense of film cameras, which then became a stagnant industry. Some film companies were able to transition to the production of digital cameras, but those that were unable

either went out of business or were forced to sell their assets to one of the successful companies.

Keklik (2003) postulated that the innovation life cycle possesses a logistic S-shaped curve over the long run. Figure 3.2 displays this S-shape curve divided into the three innovation stages as discussed by Mensch (1975). Radical innovations and very important innovations are those that occur in the first stage, important innovations in the second, and pseudo innovations in the third. This logistic S-shaped curve graphically shows how output is related to the life cycle. The slope of the curve implies that the first stage (radical innovations) initially has low output but accelerating growth with constant growth in the second (important innovation stage) as the industry is taking off. As the industry enters the third stage (pseudo innovation), firms' output is increasing at a decreasing rate until absolute stagnation is reached. In the latter parts of the third stage, a standardized product emerges with known production costs and established sales. At this point, a dominant design has become widely accepted and any innovation that arises will not be anywhere near revolutionary. This reduction of output in the third stage is attributed to the rise of new industries that have moved into the same market space as the outgoing product.

Schumpeter's innovation life cycle posits that radically new industries replace stagnant industries. The introduction of the new technologies is not immediate, but once it grabs a foothold, there exists significant competition as the weaker, less innovative firms are weeded out. As firms move through this innovation life cycle, the ways in which they finance themselves change. Equity investors will tend to prefer firms in the

earlier stages because of the higher possible returns to compensate for increased risk, while lenders will prefer firms with established credit histories and cash flows.

3.5. Financing

While many firms' financing comes from internal funds, such as retained earnings, this research is driven by decisions firms make when seeking external capital in the form of debt or equity. This is because in the earlier stages of the innovation life cycle, radically innovative firms typically have little retained earnings. I hypothesize that in the radical innovation stage, a company will not be able to raise capital through debt markets and are more likely to rely on equity markets for external capital. I argue that this is primarily a supply constraint because the level of risk to lenders is too high given the expected return. Bankers, while they may be able to see the venture as being profitable, have a limited upside in the form of an interest rate, yet will lose their entire investment if the firm fails. I propose that in order to raise funds, these radically innovative firms have a higher reliance on equity in order to be able to compensate investors for the additional risk and return volatility.

Established firms that are constantly innovating are treated in the same manner as brand new firms if the radically innovative activities consume a large portion of their activities. The main distinguishing feature is that established firms may have more retained earnings to fall back on. Under the assumption that firms will use internal funds before seeking external capital, firms entering new industries will exhaust their retained earnings, and will be more likely to raise funds through equity than firms still engaged in an old industry. The relevant factor of the above is how large a percentage of activity the

radically new technology consumes of a company. If a massive company engaged in various activities like General Electric began operating in a radically new innovation it may only be a small portion of their portfolio and would not have much influence on their external capital needs. On the other hand, a small company shifting their entire focus toward a radical innovation would be treated similarly to a brand new firm. Regardless of whether it is a new firm or established firm engaged in the radically innovative activity, their external capital decisions will be similar if the innovations pertain to a large percentage of their activity.

Traditional theory suggests that increases in the interest rate are compensation for holding risk, known as the risk premium. Charging higher interest rates on loans for riskiness is a common practice. However, high risks, like those found in radically new industries, would require interest rates that would be higher than normal rates and make it difficult for lenders to price. Merton (1974) presented the first comprehensive theory on the risk structure of interest rates. He found that bonds are more difficult to price when there is significant risk of default, and therefore, investors find these bonds less desirable in spite of the higher interest rates received. Not only do firms in new industries have higher probabilities of default, they also have large amounts of intangible capital that is difficult to price. When an asset is difficult to price, investors will discount the price. Investors will not be satisfied with the current risk premium and either i) demand a higher interest rate or ii) not lend at all. Additionally, Fisher (1959) theorized that the risk of default is a function of a firm's net past income; firms with little or no past income have a much more difficult time borrowing funds. Firms in radically new industries typically do not have long credit histories, having higher risk premiums. Suffering from the same

problem as Merton (1974), firms will have less access because of investors' reduced preference for holding bonds in young industries with more risk.

While difficulties in pricing risk do exist, once interest rates rise above a point, banks will no longer lend funds out of fears of adverse selection where the only firms accepting high interest rate loans will be bad risks. Stiglitz and Weiss (1981) conceptualized this with the introduction of credit rationing. Basic economic theory posits that market equilibrium is where supply meets demand; as prices rise, suppliers will produce more. However, debt markets act differently with credit being rationed and investors retaining their excess funds rather than lending them out. Banks care about two things: risk and return; as risk increases, the banks are induced to loan at a higher interest rate in order to compensate for the risk. The problem arises when interest rates rise as the rate increase itself may influence the riskiness of the project. Increased rates make debt service more expensive, making margins tighter and threatening the likelihood of repayment. Banks, therefore, are aware of the "lemons" problems where those who would borrow at the highest interest rates may be worse risks; the interest rates would be able to act as a screening device, keeping bad investments out. Banks may interpret the radical industries' willingness to accept high interest rates as a signal that they are poor investments, thereby rationing credit.

Over the life cycle, stock market issuance should follow a skewed distribution, as shown in Figure 3.3. At t=0, there is precisely zero stock market financing when the innovation is in its infancy. As time goes on, the likelihood of raising capital through the stock market begins to increase as the innovation appears to have a higher probability of a profitable future. At the end of the innovation life cycle, mature industries will have

steady cash flows with little need for external capital. When they do require capital, it will come through debt financing. At the time of an industry's death, there will be zero innovation, need for capital, or stock market activity. The distribution of stock market issuance is skewed to the left since most of the innovations occur relatively early in the innovation life cycle and, during the time when competition amongst firms is greatest, there will be higher activity in the stock market.

Evans and Jovanovic (1989) argue that new businesses must finance themselves and bear the risk of failure; if they are starting a new venture without an adequate pool of retained earnings, they must find a partner with the available funds. The earlier a firm with an innovation seeks financing, the higher the return must be for the investor as compensation for the high levels of risk. It is not likely that at the earliest stages those firms would seek to raise funds through the stock market. Most of this can be attributed to information costs; in the beginning when there are higher levels of uncertainty, investors would have high relative costs of obtaining the necessary information to make an investment decision.

After a company has a viable prototype ready for production, firms will require more funding in order to scale up the production. At this time, there are high capital requirements and since this radical innovation is new and lacks retained earnings, firms only options are equity and debt to provide the necessary capital. Barnhart and Dwyer (2012) found that firms in new industries have a much higher volatility in their returns, but have a much higher expected return compared to the rest of the market. Their findings indicate that a small number of companies generate outstanding stock market returns while there is a high number of firm failures. Bankers are aware of the high

potential return, but fear volatility. The firm's need for capital allows speculative investors to reap the benefits of higher risk through the stock market, allowing for the ability to diversify their investment while delivering the necessary capital to innovative firms. Into the third stage, the innovations are not substantial departures from previous innovations. This does not lend itself to high rates of return, yet presents lower risk to investors. At this time, firms still have requirements for capital, but now have the ability to raise capital through debt and retained earnings to expand production. These options allow for more flexibility in choosing the lowest cost of capital as they can attract bank financing. The difference from stage two in relation to bank financing is that the firms are able to receive a lower interest rate because of a low, measurable risk. Firms will choose the cheapest way to raise the necessary capital and with interest rates being lower than the cost of equity, the firms will choose significantly more debt financing.

To simplify, these firms involved in more innovation are considered to be in "new" industries, while firms in mature industries in the latter stages of the life cycle can be considered "old." This simplification is done for illustrative reasons as well as because of the empirical difficulties in determining firms' precise position in the life cycle. With this simplification, it can be conceded that new industries will be more innovative that those in the old industries. Since firms at the very beginning of the life cycle are required to finance themselves and bear the risk of failure, while at the end of the life cycle firms have no need to raise any funds, there will be less innovation occurring at either end of the life cycle. It is somewhere in between that innovation peaks, most likely being during the radical innovation stage (Keklik, 2003). As such,

more innovation will occur earlier in the innovation life cycle and should be indicative that firms in innovative industries will raise more funds through the stock market.

3.6. The Life Cycle and Capital Structure Theories

As shown above, the placement of firms within the innovation life cycle has important implications for how they will raise funds. Each of the theories on capital structure address different imperfections in capital markets. The market timing theory seems to ignore the issue of whether or not a firm has the ability to raise funds through debt; the main consideration is determining which avenue will be the least expensive at that particular time. This theory would first require that the firms have access to market rates for both stock and bond issuance. The life cycle addresses the Trade-Off theory's "horse and rabbit stew" problem by making the "rabbit" larger, meaning that changing the probability of default and bankruptcy costs can alter the composition of the capital structure (stew). The life cycle fits neatly into the Pecking Order theory in that the closer to the beginning of the life cycle a firm is, the lower the probability of them being able to secure bond financing, leaving radically innovative industries with the only option being to raise funds through the stock market.

3.6.1. Market Timing

Derived from the premise of firms seeking to raise capital through whichever avenue is the least expensive at that particular time, the market timing theory of capital structure assumes that firms have access to both markets. Ceteris paribus, when equity is valued higher or interest rates are high, firms will raise more funds through the stock

market. Conversely, when equity is undervalued or interest rates are low, firms will be more likely to borrow to fund their activities. For radically new industries, equity will be a more attractive option even in the absence of credit rationing. With an appropriately priced interest rate on a new firm without large amounts of cash flow, high costs of debt service may be a breaking factor. However, with equity, the firm is not responsible for making payments to their investors until they are profitable. Even at the rates these firms would be able to obtain, the firms would prefer to use the stock market to ease cash flow pressures. When the firm moves into the later stages and has steady cash flow, they will use less equity and transition to more debt. If debt or equity prices are out of line and a firm sees their value increasing by using one form or another, they will use whichever method costs the least.

3.6.2. Trade-Off

Adjusting the level of bankruptcy costs and tax benefits has important implications for the Trade-Off theory of capital structure. Tax benefits are relatively constant and easily measurable; the recent reevaluation of bankruptcy costs has brought the Trade-Off theory back into favor as the measurement allows for a direct comparison. While most of these studies attempt to quantify these costs, no unifying model of bankruptcy cost shocks has emerged. This is perhaps because these costs are expected to be quite small in relation to firm value (Warner, 1977) and that assets tend to be shuffled between firms so as to reduce the direct bankruptcy costs (Maksimovic and Phillips, 1998). However, when we alter the probability of default, the Trade-Off theory would predict a change in the optimal level of leverage. Molina (2004), for example, found that

the probability of default is endogenous to the leverage decision; bankers will realize that increasing debt levels can influence the probability of default. As such, Molina was able to estimate the level of financial distress by modeling different probabilities of default. Changing these probabilities brings the costs of financial distress into being comparable with estimates of the tax benefits of debt, being consistent with current leverage rates. Additionally, Graham and Tucker (2006) show that firms with subsidiary tax shelters use less debt, providing support for the Trade-Off theory. Effectively, these firms transfer their tax benefits to their tax shelters, removing the tax benefits from the parent company. What this does is make bankruptcy costs larger in proportion to tax benefits, shifting where the firms' optimal leverage ratio would be. Their empirical study was naturally limited in scope as data on tax shelters are kept confidential by the IRS. The literature on estimating bankruptcy costs remains limited, but what does exist shows that changing bankruptcy can alter the optimum leverage ratio.

Figure 3.4 illustrates how the Schumpeterian innovation life cycle fits within Trade-Off theory. It is assumed there are two firms: one in a "new" industry and the other in an "old" industry. The distinction between the two firms is that the firm in the new industry has a higher probability of default, yet higher potential return due to a product in the beginning of the life cycle; this is contrasted by the firm in the old industry that has a standardized product and concrete forecasts of future profits. Both firms enjoy the same tax benefits of debt and will both have a "no default" value curve at FV_{nd} and an unlevered value at the intercept, $\hat{V}$. Incorporating different probabilities of default gives two separate FV functions, FV_o and FV_n, where the subscripts respectively indicate old and new industries. FV_n, with a higher probability of default, pushes the optimal leverage

ratio, D/A_o^*, to the left as the bankruptcy costs become greater than the tax benefits at a lower leverage ratio. Firms in radically new industries still have significant profit opportunities and will turn to equity markets for the large amounts of capital they require. Firms in old industries, on the other hand, do not have as many profit opportunities or capital requirements above their optimal leverage ratio and are less likely to seek equity financing. Firms in stagnant industries with few profitable growth opportunities are not expected to even reach the optimal leverage ratio as the tax benefits of borrowing are insignificant compared to profitable investments.

It should also be noted that increasing the costs of bankruptcy also leads to a lower market value of the firm; V_n is the market value for new industries while V_o shows the higher market value for old, established industries. The market value of new firms would have to be lower in order to compensate investors for the increased risk and should be associated with higher expected returns. The firms will seek to bolster available debt funds with equity. Hsu (2009) proposes that technological innovations increase returns on stocks, finding that firms with more technological innovations (as proxied by patenting activity) are typically assigned higher risk premiums, in keeping with market valuations for firms in new industries as shown by V_n. New and radically innovative industries are associated with higher volatility and higher probabilities of default; therefore, they should also have higher expected returns. Empirical results show that firms involved in innovative industries have a higher likelihood of failure (Eisdorfer & Hsu, 2012) and there is an inverse relationship between leverage and volatility (Bradley, Jarrell, & Kim, 1984). These results are consistent with the reduced leverage ratio and valuation due to increased bankruptcy costs.

3.6.3. Pecking Order

A strict interpretation of the Pecking Order models insists that firms only issue equity when they have no other options. With restrictions in place as to what sources of funds are available, the entrepreneur that has highly profitable projects in the works will raise funds whichever way possible. Lacking any internal funds, he will seek financing from anywhere possible. Supply constraints from bankers and other lenders (bond holders) will lock the entrepreneur out of debt markets. The only other option would be to raise funds through equity markets. The relatively higher costs of equity are worth it to the entrepreneur trying to bring their product to the market. In empirically testing for the Pecking Order theory of capital structure, Lemmon and Zender (2010) primarily found that firms do prefer internal funds before going to the market for external funds. Additionally, they empirically evaluated the consideration of debt capacity, finding that when firms are unconstrained by debt they will issue debt, but when constrained by debt will issue equity. This is in accordance with the theory along the innovation life cycle, as radically innovative firms face larger constraints to debt financing and will typically lack retained earnings.

Also showing a similar result, Frank and Goyal (2003) and Fama and French (2002) were able to show that firms without a debt rating are typically small, high growth companies that tend to finance more of their activities with equity. Rather than arguing this phenomenon is driven by debt capacity, both studies argued that this is due to asymmetric information; debt investors will not be forthcoming with funds if they are unable to accurately assess the risks of default. Firms in the earlier stages of the innovation life cycle are much less likely to have longstanding records that allow for

bankers to assess the risks. This, therefore, limits the firms' abilities to use debt, turning to equity.

To restate, I hypothesize that firms in the earlier stages of the innovation life cycle will be more likely to raise funds through the stock market than firms in the later stages. In the earlier stages of the innovation life cycle, when firms are engaged in radically new technologies, they will have high capital requirements and be a questionable risk for bankers. Because of the limited upside in the form of an interest rate and a reasonable likelihood of default, debt will be less of an option; these highly innovative firms are then left with equity as a more viable option. Due to data limitations on pinpointing where firms fall within the innovation life cycle, it is also difficult to track firms' specific financing choices over the life cycle. Because of this, empirically testing the direct relationship between firms over the life cycle and their stock/bond choice is not possible. It is, however, possible to test whether firms engaged in highly innovative industries are more likely to raise funds through the stock market rather than the bond market. Since more innovative activity will occur at the beginning of the life cycle, this will be an acceptable way to show support for the idea that firms in the earlier stages of the life cycle will be more likely to raise capital through the stock market.

3.7. Empirical Methodology

Difficulties with pinpointing where firms fall in the innovation life cycle make it infeasible to directly test for what kinds of financing decisions firms will use over the life cycle. What we are able to test for is whether firms in innovative industries are more likely to raise funds through the stock or bond market. Since innovation will occur

earlier in the life cycle, showing that firms in industries with higher levels of innovation raise more funds through the stock market will be able to lend evidence to the life cycle financing hypothesis. The empirical section presents an unbalanced panel of stock/bond issuance, patent activity, and various control variables for the time period 1970 to 1992. 1970 was selected as the beginning of the time period because of the reliability of data on stock and bond issuance before that time is questionable. Having the observed time period stop at the end of 1992 was to exclude the wave of stock offerings in the mid-1990s as it could skew the results. As most observers are aware, the mid-1990s saw an incredible number of technology companies issue IPOs. Since most of these companies were in brand new industries, this time period was marked predominately by firms in radical industries issuing equity, supporting my hypothesis.

The set up of the empirical models is performed as is standard in the literature, following the basic specifications of Choe, Masulis, and Nanda (1993). In this case, the dependent variable is *firm* level stock market decisions, with the important explanatory variable being *industry* patenting while controlling for other *industry*, *market,* and *time* conditions. Considering the two types of financing in each time period, firms had an option of financing their operations by using debt, or equity. The dichotomous relationship of choosing to raise funds through equity or debt financing makes using a simple linear regression a potentially hazardous method of estimation. For this reason, I am using a probit model estimating the probability of raising funds through the stock market relative to bond financing based around the simplified regression equation:

$$P(Stock\ Market)_{f,i,t} = \beta_0 + \beta_1 Industry_{i,t} + \beta_2 Market_t + B_3 Time + \varepsilon_{t,i.t} \quad (3.1)$$

Where $P(Stock\ Market)_{f,i,t}$ is the probability of firms raising capital through the stock market, and is defined at *firm* level, *f,* in *i* industry in the time period *t*. Since we are interested in the instances where firms are seeking external capital and there are only two options, bond and stock, the probabilities of raising funds through the bond market, $P(Bond\ Market)_{f,i,t}$, must be equal to $(1 - P(Stock\ Market)_{f,i,t})$. $Industry_{i,t}$ represents the industry level variables for all firms, *f*, within the industry, i. The industry level contains the important explanatory variable of industry innovation/patenting activity. An additional industry-level control of returns will also be included. I am controlling for various time variant market conditions with $Market_t$; within this are a number of market factors traditionally in the literature and discussed in detail in the section below. The $Time$ variable is a time trend controlling for controls for varying conditions over time.

Because of the possible presence of intra-industry and time correlations in the error terms, it is important to cluster standard errors. Within my data, there are industry and time variant effects. I am treating heterogeneity bias by removing the interindustry effects and time (year) effects. As such, I am clustering the standard errors at the industry/time level. Within the dataset, there were 25,064 instances of firms raising capital across 71 industries and 46 time periods; clustering at the industry/time level results in a maximum possible 3,266 observations. However, there were periods where no fundraising activity occurred for a specific industry, leaving 2,106 total independent observations.

3.7.1. Data

The dependent variable is this model is the ratio of stock market financing to the total amount of financing received in each time period. The dataset incorporates all stock and bond issuance occurrences in the United States between 1970 and 1992 as reported in the Thomson Reuters SDC Database. The dependent variable, *SB.Ratio* is given as:

$$SB.Ratio_t = \frac{Stock\ Market\ Financing_t}{(Stock\ Market\ Financing_t + Bond\ Financing_t)} \quad (3.2)$$

Fund raising activity has been organized into 6-month time periods in order to gather a complete picture of their total external fund raising activity. Firms may have large capital requirements and raise funds from numerous sources. Each time period is organized as January through June and July through December, for a total of two time periods in each year between 1970 and the end of 1992 for a total of 46 time periods. For example, when t=1970, it indicates the first 6 months of 1970; t=1970.5 indicates July through December of 1970; etc. These time designations are used for every variable in this model; firm fundraising, industry patenting, and market considerations are all factored over the 6-month time periods.

The value of the dependent variable for a firm that raises capital only through the bond market would equal zero, while a firm who raised all their funds through the stock market would equal one. As can be seen from firm's actions in capital markets, it was unusual for a firm to raise capital through both stock and bond issuance in the same time period. Of the 25,153 fund raising instances, there were only 89 where a firm raised capital through both the bond and stock market in one of the 6-month time periods.

These 89 instances present an interesting anomaly as the only plausible explanation as to why a firm would seek both bond and stock market issuance in the same time period would be that the costs/benefits were exactly identical. This rare occurrence, 0.3%, demonstrates that firms are unlikely to seek funds through both avenues simultaneously. These are dropped from my analysis and will allow for the use of binomial regressions, leaving 25,064 instances of firm level fund raising. This leads to a simpler dependent variable, where:

$$SB.Ratio_{f,i,t} = \begin{cases} 1, & fund\ raising = stock\ market \\ 0, & otherwise \end{cases} \tag{3.3}$$

Table 3.1 shows the total number of stock and bond issuances by year along with a simplified ratio of instances of stock financing to total financing activities; this is computed as IPO/(Bond + IPO). There is significantly more activity in the bond market relative to the stock market, with minimal activity from the mid- to late 1970s. The total dollar value of the bond market issuances is substantially larger than the fundraising used through stock issuance; the ratio of funds raised through the stock market is in the column labeled SB.Ratio. Figure 3.5 shows the total number of fundraising instances graphically across time and Figure 3.6 displays the total dollar value of the fundraising activities. It becomes evident that fundraising activity significantly increases beginning in the early 1980s after being stagnant through the 1970s. After the change around 1980, the number of instances where firms have gone to the bond market for financing has been increasing at a relatively steady pace in contrast to the instances where firms raise funds in the stock market. The trend in stock market issuances also increases in the early 1980s

but exhibits far more variation than the bond market. This variation is indicative of underlying elements driving stock issuance.

Figure 3.7 displays the distribution of how many times a firm enters the market for external capital. The horizontal axis displays the number of time a firm appears in the sample while the vertical axis is the number of firms that are included in each group. Of the 12,131 firms that raised capital through either the bond or stock market in the time period the vast majority, 8,571, only went to the market a single time. Firms that raised capital less than five times between 1970 and 1992 represent 93.5% of the observed firms. The large number of firms with limited observations precludes the ability to use a dynamic panel or fixed effects model. For example, the use of a fixed effects model would result in the dropping of 96.7% of observations.

3.7.2. Industry Level Variables

These data include all patents issued by the United States Patent and Trademark Office (USPTO) and compiled by Hall, Jaffe, and Trajtenberg (2001). The relationship between where a firm is in the life cycle is as follows: stock market issuance correlates with patenting, innovative industries patent more, and more innovation occurs at the beginning of the innovation life cycle. The empirical estimations of this paper are focused specifically on the relationship between patents and stock market issuance. Griliches (1998) acknowledged some of the difficulties in using patents as a proxy for innovation. He argued that in spite of their difficulties, they are still quite useful; they are freely available, based on an objective and slow-moving standard, and are by definition related to innovation. The major concerns with their use are questioning the consistency

of standards and whether conclusions can be drawn from across time. The second issue of patent standards not being consistent across countries is not a relevant concern in this paper as only United States patent data are examined.

The patent data used in this analysis includes only utility patents granted in the United States as these are issued for the invention of "any new and useful process, machine, manufacture, or composition of matter, or a new and useful improvement thereof…" (Patent Laws and Regulations, 2000, p. E-25) and are generally referred to as "patents for invention." Since these patents are intended for new inventions, they proxy rather well for radical and important improvement innovations. This data set excludes plant and design patents as these patents cannot be considered radical innovations as creating a plant with a higher yield, or that is more pest resistant, is not a radical departure from previous plants; design patents are a similar case as they only apply to "new, original, and ornamental design for an article of manufacture" and are, therefore, more akin to pseudo-innovations.

Industry level patenting is important; path-breaking innovations generated by innovation come in clusters, providing more opportunities for innovation by others in the industry. While one firm in an industry might be the leader in patenting activity, there will be a large number of other firms attempting to bring the product to market. Industries with higher levels of patenting will contain more innovative firms. Information as to which firms are going to survive and succeed is not known with any level of certainty, but accurate forecasts of the success of the wider industry is known by most investors. Pastor and Veronesi (2005) found that during technological revolutions investors will diversify their investments among many in the industry. This is done

because some will be winners, others losers, and it cannot be known a priori who will be the winners.

Patent data from the USPTO are classified by internal codes that are not relatable to other variables. Hall et al. (2001) were able to relate the internal USPTO codes to industries and other outside factors through a 3-digit US Patent class. This US Patent class is assigned to the appropriate 2-digit SIC industry codes; the broader 2-digit codes were chosen because of the necessity to incorporate the spillover effects on closely related industries. Due to the way assignments are referenced by the USPTO, some patents were referenced in a number of industries. When this occurred, patents with applicability in multiple industries were included with the total count of patents for each industry they referenced; this results in total patent counts being overestimated. During the time period, the total amount of actual patents was just under 1.9 million while my assignments resulted in just over six million assigned patents. This is the optimal practice as there are innovations that have a wider application, and attempting to select a single industry for these would result in subjective assessments of the data. Patents are reported according to the year they were received; the time periods, however, are every 6 months. To reconcile this, the way the patents are assigned was to place the half of the yearly number of patents in the first half of the year (e.g., 1970, 1971, etc.) and then assign the second half of the year as the average of the two surrounding time periods (e.g., 1970.5 = (1970 + 1971)/2). Assigning patents in the manner allows for continuous patenting data. A summary of the patents received by industries with the aggregate *SB.Ratio* can be found in Table 3.2.

In all industries with 2-digit SIC codes above 57, there are zero patents granted; this represents 27 of the 71 industries without patent activity. After excluding design and plant patents, these industries did not have any utility patents; the majority of these industries are involved in the service sectors where product and process innovations would be rare. Due to the possibility of skewing the model results, a secondary model excluding all industries above 57 will be estimated alongside the original model, and their estimates will be compared. Removing these industries results in a reduction of sample size from 2,106 to 1,442 observations. Although this is a large reduction in sample size, it is not expected that any significant changes will occur.

Following the market timing literature, when stock values are higher, firms are more likely to raise funds through equity. While market returns are also included, industry returns are also necessary to control for since individual industries do not necessarily correlate with the wider market. One of the main considerations for the inclusion of industry controls is that if an asset price bubble is emerging in a specific industry, the valuations a radically new firm would receive could be greatly overvalued. These high valuations could be an easy decision for a firm to raise capital through equity. Time-variant stock returns for industries are included to pick up the industry level variation that could be overlooked by returns from the entire market. It is expected that as industry returns rise, there will be more stock market issuance because of the higher valuations associated with the industry.

Industry returns data are from the Center for Research in Security Prices (CRSP) and incorporates all publicly listed stocks in the United States on NYSE, AMEX, and NASDAQ exchanges. This index was then computed as a market cap-weighted price

index according to the 2-digit SIC codes. This computation is accomplished by computing the return accrued from the overall industry. The returns over the period were computed as a simple percentage change from the beginning of the period to the end of the time period based on the cumulative industry prices of publicly traded stock. In some of the smaller industries where there is less external capital raised, there were not any publicly traded stocks. This was the case for 59 of the fund raising instances; these without any corresponding public stocks were discarded from the analysis.

3.7.3. Market Control Variables

In order to control for hypotheses proposed by market timing theorists I use a number of variables to proxy for market conditions. These are time variant and include: the business cycle, interest rates, market return, and other constructed variables commonly used in the literature. Complete data descriptions can be found in Table 3.3.

The business cycle plays a key role in the fundraising decisions surrounding firms due to its effects on both investor and company expectations. The expected impact of the business cycle on *SB.Ratio* is ambiguous. It could be negative since when the economy is in an expansion, equity tends to receive a higher market value, leading to more stock issuance relative to bonds. It is also possible to be positive since in times of economic expansion lenders typically assign lower probabilities of default and bankruptcy. Supporting this idea, Choe, et al. (1993) found evidence that common stock offerings are positively correlated with the business cycle. With a positive correlation, supply constraints placed on innovative firms will be lessened and firms will raise more funds through the stock market.

I am controlling for the business cycle using the official estimates of US Business Cycle Expansions and Contractions as released by the National Bureau of Economic Research (NBER). The NBER defines a contraction as significant declines in a number of factors: real GDP, real income, employment, industrial production, and wholesale-retail sales. The subjectivity of these measurements is used alongside the traditional definition of a recession as two consecutive quarters of decline in real GDP in order to more accurately date the peaks and troughs in the changes of economic activity.[3] The time between the trough and the peak was considered to be a time of economic expansion, while contraction was the time following a peak until the trough was reached again. I fashioned a simplistic dummy variable with expansions equal to one and contractions equal to zero. Since the exact peak and trough are not likely to be assigned on exactly January 1 or July 1, they are going to fall somewhere within the 6-month time periods. For this reason, the 6-month time periods that included a peak were assigned the expansion value of one, while those including the trough received the contraction value of zero.

To account for changes in interest rates, I use the rates on 1-month and 10-year treasury bills. The reasoning for including interest rates is that there is a positive relationship between interest rates and costs to service debt; when these costs rise, firms should be more likely to look to equity financing since the costs of stock market financing have become less expensive relative to debt. It is expected that the coefficients attached to the different interest rates is positive. The short-term and long-term are both used in order to be inclusive of the decisions firms may make. While long-and short-term

[3] For a complete description of how the NBER dates the business cycle, please see the most recent NBER announcement, dated 09/20/2010.

interest rates typically move together, we expect that the long-term interest rates will have more of an impact on stock market issuance since most future projects are based off long term debt contracts.

The "risk free rate" (one month T-Bills) is also included in order to assess the difference in market returns to the risk free rate. Most of the market timing literature posits that there is a positive relationship between short-term interest rates and stock issuance. It is purported to exist for the same reason as long-term interest rates; increased interest rates raise borrowing costs which make equity relatively cheaper. However, there exists the possibility of a negative relationship. One month T-Bills, considered "risk free," is the reference rate all other investments are compared to. When this rises, investors will require higher expected returns from any other investments that carry risk, thereby discounting any equity issues. The costs imposed by a lower valuation could be greater than any incremental increase in debt service.

The other factor of stock/bond issuance is the current market return; if the market seems to offer a higher return on stocks, investors will pay more for a stock offering; the higher valuation means the firm has a higher likelihood of being overvalued and, therefore, is going to be more likely to raise funds through the stock market. This variable, *Mkt Return*, is measured as the weighted average equity return of the Standard & Poor's 500 Index over the 6-month time periods. The S&P 500 is used because it is one of the most followed indexes of equity returns, and its diversity makes it an indicator of the health of the United States economy. The expected coefficient of market return should be positive; when the stock market is booming and there are high returns, firms' value is increasing and will be more likely to raise funds through equity issuance.

An additional variable used for determining relative returns to both investors and firms is *MKTRF*, which is the difference between the market return and the risk free rate. The measurement of market return under this variable differs from the variable *Mkt Return* in that it is the value-weight return of all firms in the Center for Research in Security Prices (CRSP) database incorporated in the United States and listed on the NYSE, AMEX, or NASDAQ rather than the more narrow S&P 500. For consistency, this definition of market return is used because *MKTRF* is a component of the Fama-French model discussed in the below section. It is expected that there will be a positive relationship between *MKTRF* and *SB.Ratio*. The intuition is that when *MKTRF* is higher, equity is receiving a greater return relative to debt, and there is a reasonable likelihood that equity is overvalued by the market. Perhaps one of the most important single variables, this difference is a direct test of the difference between returns to equity and debt.

The basis of many portfolio theories is the Fama–French and Carhart models of portfolio returns. The variables from these models will act as important controls since rational investors will evaluate a variety of portfolio choices, making their investment decisions based on the underlying factors. For this reason, the variables included in these models make good control variables. Since my contention is that increased innovation should lead to higher incidence of stock market issuance due to higher risk, investors must be compensated for this additional risk. Some of the underlying factors of returns are also included as control variables; in a perfect capital market these additional factors would add nothing to the analysis. The Fama–French Three Factor Model (Fama & French, 1992,1993) builds on the Capital Asset Pricing Model (CAPM; Sharpe, 1964).

In addition to CAPM's accounting for nondiversifiable market risk, Fama–French incorporates the observation that small caps and value stocks (high book to market value) tend to do better than the market as a whole. Additionally, returns must be corrected for the risk associated with holding the particular stocks. This relationship between returns above the risk-free-rate can be defined as:

$$ER = Return - Risk\text{-}Free\text{-}Rate = a + B*Mkt + B*SMB + B*HML + e \qquad (3.4)$$

Small-Minus-Big (*SMB*) is a measurement of the percentage of small cap versus large cap stocks within a portfolio. A higher *SMB* indicates that the market has a higher proportion of small companies than large. Since small firms are more likely to require equity financing, the expected correlation between *SMB* and *SB.Ratio* is positive. The other variable in this model, High-Minus-Low (*HML*), is a portfolio measurement of the percentage of value stocks (high book to market value) relative to growth stocks. Radically innovative firms fall under the growth category because they do not have as many assets as the old industries and much of their value lies in intangible assets. It is expected that the correlation between *HML* and *SB.Ratio* is negative since a higher proportion of value stocks precludes that the industries have less intangible assets and more access to debt markets.

Expanding the Fama–French Three-Factor Model is the Carhart Four-Factor Model (Carhart, 1997). This asset pricing model adds an additional variable known as momentum (*UMD*); this variable is derived from the idea that stocks have "memory," where a stock that has done well in the recent past is likely to continue the trend, and

those currently doing poorly will continue on their current trend. Each of these variables is used by many fund managers to assist in their decisions for building a diversified stock portfolio. The basic Four-Factor Model is represented by:

$$ER = a + B*Mkt + B*SMB + B*HML + B*UMD + e \quad (3.5)$$

Substantial debate has arisen in the literature as to whether a momentum strategy is actually profitable, with a number of empirical studies arising to test whether there is a basis for it. Jegadeesh and Titman (1993) document a simplistic trading strategy of buying stocks that performed well in the past and selling those with poor past performance, finding profitable strategies in holding these stocks for 3- to 12-month time periods. Momentum could influence strategies based around market timing, in that if firms are accurately able to time the market, they would be closely following the market. If issuing stock, the firms would seek to issue at precisely the right time. The expected direction of correlation would be positive as momentum in the positive direction would imply a higher valuation for the stock. Conversely, Conrad and Kaul (1998) find no statistical difference between using a momentum or contrarian strategies. A contrarian strategy is the exact opposite of a momentum strategy; it is based upon the premise that markets overreact to news events and that the most appropriate trading strategy would be to purchase those with recent losses and short the stocks with recent gains. Furthering this result is the finding that the large cross-sectional variation could account for the gains observed from a momentum strategy. Being unable to tell any statistical difference

between two polar opposite trading strategies makes it questionable whether they will enter significantly into any of the estimations.

Although the unbalanced nature of the sample makes using a dynamic panel model suboptimal, it is still necessary to control for changes across time. The time trend is controlled for by transforming the years into an index beginning at 1. This is accomplished by subtracting 1969 from each time period, resulting in a range of time periods from 1 to 23.5. It is expected that the direction of correlation will be positive as firms seem to be much more open to financing through the stock market due to the observation of more financing beginning in the early 1980s. It is also possible that there is not any relationship since bond financing was also increasing throughout the period at a similar rate.

3.8. Results

There were four basic cohorts of models with eight individual models within each, for a total of 32 estimations. In each of these, evidence in support of my hypothesis that innovative firms are more likely to pursue financing from the stock market relative to the bond market is found. The first of these cohorts directly tests the market timing variables to control for market circumstances and is shown in Table 3.4. Industry returns are added and presented in Table 3.5. Table 3.6's results are based around the Fama-French and Carhart models, incorporating the business cycle and industry controls. The eight individual models that generate the best fit from the above cohorts are reported in Table 3.6 and incorporate the additional time trend variable. Table 3.7 then presents results from a reduced sample, comparing results to the above models. Each table

provides coefficients, standard errors, statistical significance, and the marginal effects at the median for each variable, along with Variance Inflation Factors (VIF) testing for multicollinearity.

Testing the hypothesis that more innovative firms are more likely to raise funds through stock market issuance uses the number of patents granted (*PGrant*) as a proxy for innovation. As such, we expect that as more patents are granted, firms should become more likely to raise funds through equity issuance. *PGrant* enters into every estimation highly significant, effectively showing that firms in industries with large amounts of innovative activity will be more likely to raise funds through the stock market than those in industries without technological innovations. *PGrant* was significant at least at the 0.1% level in every estimation. The marginal effects did not vary much, and a one standard deviation increase from the median[4] in granted patents ranges between a 1.27 and 1.62% increase in probability of raising funds through the stock market with an average of 1.42%. Considering that the probability of raising funds through the stock market remained around 8.4%, a one standard deviation change from patent grant's median of 1.42% is substantial. Regardless of which controls were added to the model, there were only small changes in coefficients, *p*-values, or marginal effects observed for *PGrant*, resulting in strong support for my hypothesis.

3.8.1. Base Model

The basic model estimating the effects of innovation on stock market issuance is based around the market timing literature with results presented in Table 3.4. Controls

[4] The median was used rather than the mean due to a skewed distribution of patents. Computing from the mean would create an upward bias and overstate the effect of patents.

used in this model include estimating the influence of the business cycle (*Bus.cycle*), short-term and long-term interest rates (*RF* and *10.YrT-Bills* respectively), and return on the market (*Mkt.Ret*). Because of the relationship between short-and long-term interest rates and the perceived importance of market returns, model selection includes a number of combinations.

The important, explanatory variable, *PGrant*, did not face much variation within the results from the models included in the first estimations. Results from these estimations show coefficients for innovation (*PGrant*) in a tight band from 0.044 to 0.046, with statistical significance at the 0.1% level in every estimation. Where this becomes important is to determine the changes in the likelihood of raising funds through the stock market relative to the bond market. An increase in one standard deviation change in patenting activity from the median will result in a higher likelihood of raising funds through the stock market between 1.29 and 1.47%. The differences between the least innovative industries are a significant number of patents; the difference between the most and least patenting industries results in the most innovative being 14.25% more likely to raise funds through stock market issuance.

The business cycle (*Bus.Cycle*) plays an important role in the decisions firms make when they are seeking external capital. *Bus.Cycle* enters significantly (at the 5% level) into three out of seven regressions it is included in, with one of those being significant at the 1% level. Computing the change in the likelihood of raising stock versus bonds on the models where *Bus.Cycle* is significant, a discrete change results in a change in the likelihood ratio between -2.00 and -2.74%. Effectively this means that during expansions, firms are at least 2% more likely to raise funds through the bond

market; the intuitive explanation for this is that lenders assign a lower probability of default when the economy is expanding and will ration credit less.

The inclusion of the two interest rates (*10YrT-Bill* and *RF*) provided some surprising results. Where we would have traditionally thought that increases in the interest rate (in both the short and long term rates) would lead to higher borrowing costs for the firm, creating an incentive to seek equity financing, we actually see the opposite. Sign flipping can be viewed on *10YrT-Bill* when short-term interest rates (*RF*) are included, yet are still statistically significant in every model it is included in. The interaction of these two interests rates are expectedly related and show some collinearity between them. On the two models where they are both included (5 and 6), the mean VIF jumps to 2.25 and 2.07. Using the rule of thumb that VIF values above 5 needs to be reevaluated, these models would be acceptable. However, individual VIF values for *10YrT-Bill* and *RF* are both around 3.5 and tolerance values below 0.3, meaning that these variables show some collinearity. Even though these two variables are collinear with each other, no adjustments to the model are made as they are not collinear with or change the variable of interest, *PGrant*. If it were attempted to quantify the individual impact of these variables out of collinear estimations, confidence in my estimates would arise. Since I am not attempting to quantify the impact of these interest rates and am only using them to control for external factors, it is acceptable to leave the model as is, report the results, and acknowledging the limitations. This decision was made because the inclusion of the variables provides a better fit as both interest rates can influence the costs incurred by firms when seeking capital.

RF displays strongly negative coefficient values between -40.408 and -108.048, and they are significant at the 1% level. The one standard deviation change in the likelihood ratio from over 2% when *10YrT-Bills* are included drops to under 1% when it is excluded. This negative coefficient indicates that as the risk free rate increases, investors will require a higher return on any other investments since the risk premium is indexed off the risk free rate. These higher returns must come from a lower valuation assigned to firms looking for capital through equity issuance. The strength of the coefficient indicates that the effects on the costs of debt service are far outweighed by investor requirements for equity returns.

The relationship between *10YrT-Bill* and *RF* shows the possibility of joint effects. The interesting thing to note is that the only time the coefficients attached to T-Bills are statistically significant is when both variables are included in the same model. By itself, X has a negative, insignificant coefficient while the inclusion of Y turns it into being positive and statistically significant. The coefficient for Y also changes as X are both in the same model as Y's coefficient increases in magnitude. A possible explanation of this phenomenon is that financing decisions are sensitive to the spread between the interest rates. These coefficients support the notion that as the spread widens between interest rates, firms would be more likely to raise funds through the stock market. The intuition would be that since investments are risk adjusted to the risk free rate, that as the spread widens between the variables, long-term debt becomes more expensive relative to other avenues of financing. Under the assumptions of the market time theorists, this could influence a shift away from debt to equity as firms attempt to maximize their value.

Past market returns (*Mkt Return*) are strongly associated with stock market issuance. The average coefficient of 9.8 is in keeping with the predictions of theory. As the market return rises, firms' valuations rise with it; at higher valuations, firms will be more likely to raise funds through equity issuance. Highly statistically significant at the 0.1% level, this variable has relatively high marginal effects, with a one standard deviation change from the median changing the likelihood of raising funds through the stock market between 1.31 and 1.45%. Even controlling for interest rates, high past market returns are a significant indicator that firms will be more likely to issue equity.

3.8.2. Industry Returns Cohort

The second cohort of models on the determination of the stock/bond choice includes industry controls (*Ind.Returns*), with model selection being identical to the first cohort; results are reported in Table 3.5. Controlling for industry returns should pick up any industry factors that went excluded in the first cohort of models as those controls were purely based off the market. There are only minor changes for *PGrant* and the other control variables; this variation is subtle enough to not question the results from the first models.

According to VIF tests, the only models with elevated VIF levels are 13 and 14, which include *RF* and *10YrT-Bills* as the collinear factors, discussed in the base model cohort section. Including the industry return control variable should pick up any inter-industry variation. The results from this variable are insignificant in every model. It was expected that there would be some differences among industries that would drive any

debt/equity decisions. The dominance of market returns seem to point to the wider market as being more important in determining capital decisions than industry returns.

3.8.3. Fama–French Cohort

Model selection on the third cohort is based around variations of the Fama–French and Carhart models with the addition of business cycle factors and industry controls. Results from these Fama–French estimations can be found in Table 3.6. *PGrant* remains statistically significant at the 0.1% level and displays little change from the earlier models. Even though there exists the possibility of multicollinearity for these variables because of the inclusion of variables from the model on both sides of the Fama–French model formulation, according to the VIF tests, multicollinearity does not appear to be a problem that needs correction.

As *MKTRF* rises, there is a greater disparity between returns and the reference of the risk free rate. This implies a higher market value, on average, for equities. When investors in the market place higher values on equities there is a higher likelihood that a new issue will be overvalued and bring firms more funds. This is evidenced by positive coefficients ranging between 7.254 and 7.962 with a one standard deviation change in the likelihood ratio from 1.92 to 2.10%. *MKTRF*'s coefficients and statistical significance remain relatively constant with a considerable impact, indicating that the difference between the returns and the interest rate is an important factor. One interpretation is that as the gap rises, there is the potential of a bubble emerging; when a bubble has emerged, there is the possibility of having IPO waves like what were seen in the dotcom bubble and subsequent burst.

The inclusion of all the Fama–French variables can be troublesome within the regressions because as specified by Fama–French, *MKTRF* is set up on the left side of the equation with the factors on the right side. This is noticed by the elevated mean VIF in models 22–24, but is not significant enough to warrant adjustment of the models. Since *SMB*, *HML,* and *UMD* are expected to be some of the underlying factors on increases in the return to a portfolio, it is expected that *MKTRF* will dominate the results obtained for the individual components. The dominance of *MKTRF* explains some of the sign switching experienced by *SMB*, with the remainder being attributed to the collinearity. The inclusion of all variables in model 23 shows statistical significance only for *PGrant*, *Bus.Cycle*, and *MktRF*.

SMB only becomes significant in one of the estimations—when *MKTRF* and *HML* are not included. As *SMB*, the percentage of small cap to large cap stocks, rises, there is the expectation that returns to the portfolio will also rise. Knowing that as investors' portfolios become more loaded with small cap stocks, the market should have higher valuations and enable more firms to raise more external funds through the stock market. *HML*, high book-to-market to low book-to-market values, is traditionally a good metric to use when forecasting future returns to a portfolio. Falling into a similar collinearity problem as *SMB, HML* is highly correlated with *MKTRF*. As such, both HML and SMB are insignificant when MKTRF is included in the same estimation. However, *HML* appears to be more significant than *SMB* as it is statistically significant at the 5% level whenever *MKTRF* is not included, even though the marginal effects are not substantial. *UMD*, the momentum factor as an element of the Carhart Four Factor model,

is not significant at any level and displays large standard errors. *UMD* was not expected to show any level of importance due to the averaging over the 6-month time periods.

3.8.4. Time Trend Cohort

Results from the inclusion of the time trend are reported in Table 3.7. Model selection was based on selecting the models with the best fit from the above cohorts. The inclusion of the time factor does not alter the estimates on *PGrant*; the coefficients and statistical significance remain at similar levels. Using the models with the best fit tightens the band within which a one standard deviation change in the likelihood of issuing stock ranges between 1.37 and 1.41%. Within these models, the only Fama–French variable to remain included is MKTRF; it also excludes *Ind.Returns* as it does not appear to be an important indicator of decisions regarding stock market decisions.

Over time, increases in stock market issuance are viewed so the inclusion of the time trend provides the expected positive, statistically significant relationship in half of the models. In these, *Time* was significant at the 5% level and has a one standard deviation move in *Time* results in marginal changes at the median of between 0.73 and 1.05%. Three of the models display significance at the 10% level, and are when *Mkt.Returns* and *MKTRF* are included. With an average marginal effect at the median of 0.77%, meaning that every 5.66 years there is an increase in the probability of raising funds through the stock market of 0.77%.

When the controls are included, they present the expected signs and statistical significance. Immediately evident, the exception to this is *10YrTBills* which loses its significance everywhere it is included. Perhaps most interesting is that *MKTRF* is highly

significant at the 0.1% level and dominates the results from the other control variables. Secondarily, when this variable is included are the only times when *Bus.Cycle* enters significantly. The inclusion of these two variables appears to be important indicators of whether a firm will raise funds through stock and would lend some evidence to the market timing theories of capital structure.

3.8.5. Reduced Sample

As noted in the data section above, after the exclusion of design and plant patents, there was no patenting activity reported for 2-digit SIC codes 59 and above. Due to possibility that these nonvalues could skew the results, the models were then rerun including only the industries with utility patent activity reported; this reduces the sample size by 32%, from 2,106 in the full sample to 1,442 in the reduced sample, clustering for industry/time. Results are reported in Table 3.8 with the model selection identical to the time trend cohort of models.

Excluding a significant chunk of the observations without patenting activity could produce drastically different results for *PGrant* than for the models, including the full sample as this is excluding industries without any patent activity. However, this sample size reduction does not greatly affect the coefficients and statistical significance attached to *PGrant*. *PGrant* is still significant at the 0.1%, with standard errors widening slightly from 0.009 to 0.011. Of note is that even with removing a large portion of the sample without any patent activity, marginal effects have increased from an average of 1.41 to 1.60%.

Perhaps the most distinguishing feature of these regressions is that *Bus.Cycle* is no longer statistically significant in any model. The only plausible explanation for this phenomenon is that this expansion/contraction variable is not as important in the reduced sample and that changes influenced by the business cycle are picked up by other market factors. The risk free rate also is not significant in the reduced sample models, yet market returns and *MKTRF* retain their earlier results. The end result of the reduction in sample size is that the relationship between *PGrant* has been strengthened, yet some of the other market variables become less significant. Some of this can be an artifact of removing a substantial portion of firms and industries in the sample. However, this analysis provides substantial evidence that firms with higher innovative activity/patenting will be more likely to raise funds through the stock market than less innovative firms while controlling for potentially confounding variables.

3.9. Conclusion

In answering the question of when firms seek equity financing over debt financing when searching for external capital, it was hypothesized that radically innovative firms at the beginning of the Schumpeterian innovation life cycle will be more likely to look to equity than firms at the end of the life cycle with less innovative activity. The primary contribution of this paper was linking this life cycle to firm capital structure and decisions firms make when attempting to raise external capital through the bond and stock channels.

As shown in the above analysis, firms in radically innovative industries are more likely to raise external funds through the stock market versus the bond market than firms

in mature industries. Strongly significant results are obtained for *PGrant* when controlling for time, industry returns, the Fama–French factors as well as a variety of market factors, including short-and long-run interest rates, returns on the market and business cycle factors. Future research would seek to incorporate some of the additional considerations firms make when seeking external capital. This research added the element of innovation within the Schumpeterian innovation life cycle to the dominant theories of firm capital structure. While each of the capital structure theories is explained in a different way, radically innovative firms, having lower leverage, are consistent across models.

By using patent activity as a proxy for innovative activity I find statistically significant evidence that innovative firms are more likely to raise capital through equity issuance than firms without innovative activity. By using patents as a proxy for innovation, I am able to show that firms with more patent activity have a higher likelihood of raising funds through the stock market using probit estimation procedures and clustered standard errors. The impact of patents was far from insignificant and appeared as a much stronger predictor of firm financing than some of the other prominent variables in the literature. A limitation of this study is the inability to pinpoint where in the innovation life cycle firms are when they are seeking external capital. This is an avenue in which future research would be able to contribute; the determination of where the transition points occur and at what point firms begin searching for equity financing through the stock market would be of significant value. The other path in expanding this research is to formalize the relationship of the innovation life cycle to models of capital structure.

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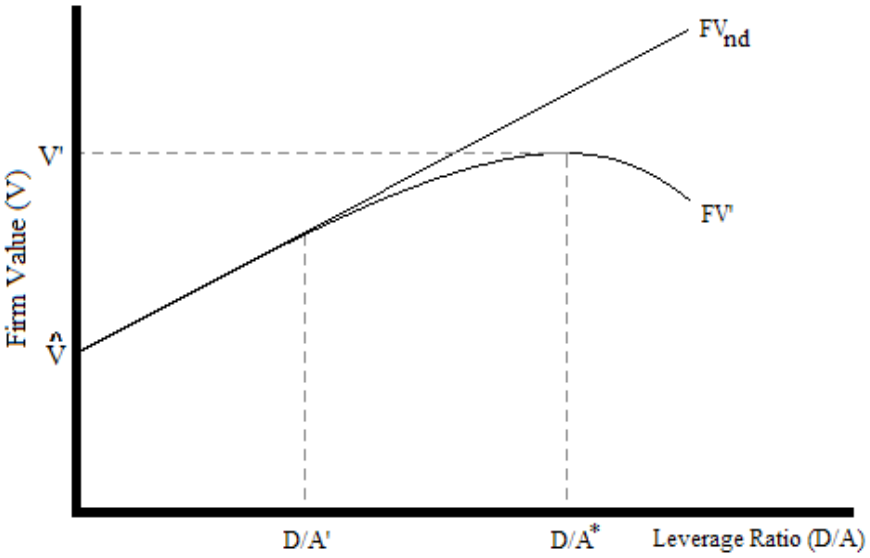

Figure 3.1: Trade-Off Theory

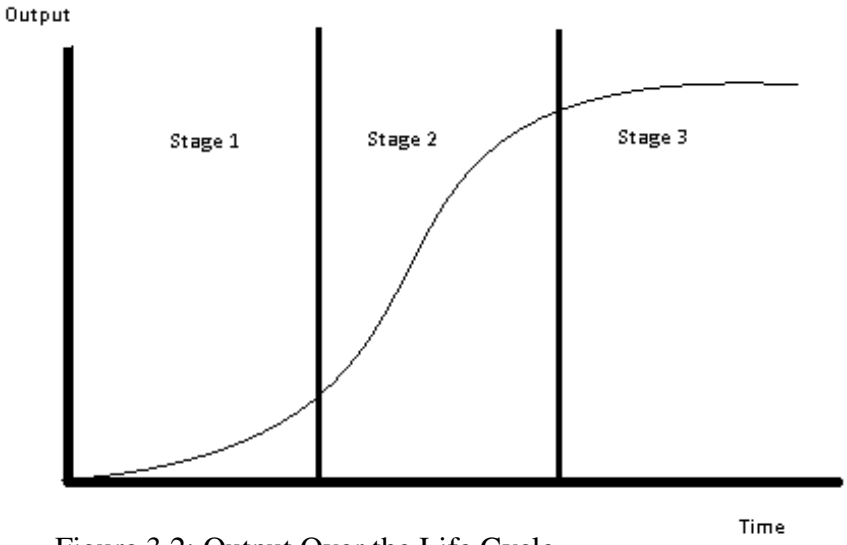

Figure 3.2: Output Over the Life Cycle
Source: Keklik (2003)

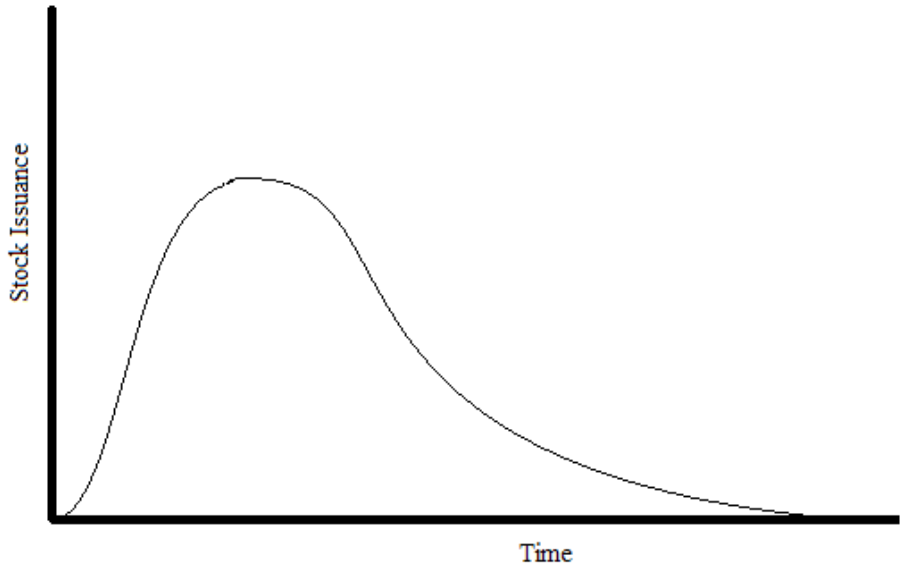

Figure 3.3: Stock Issuance Over Time

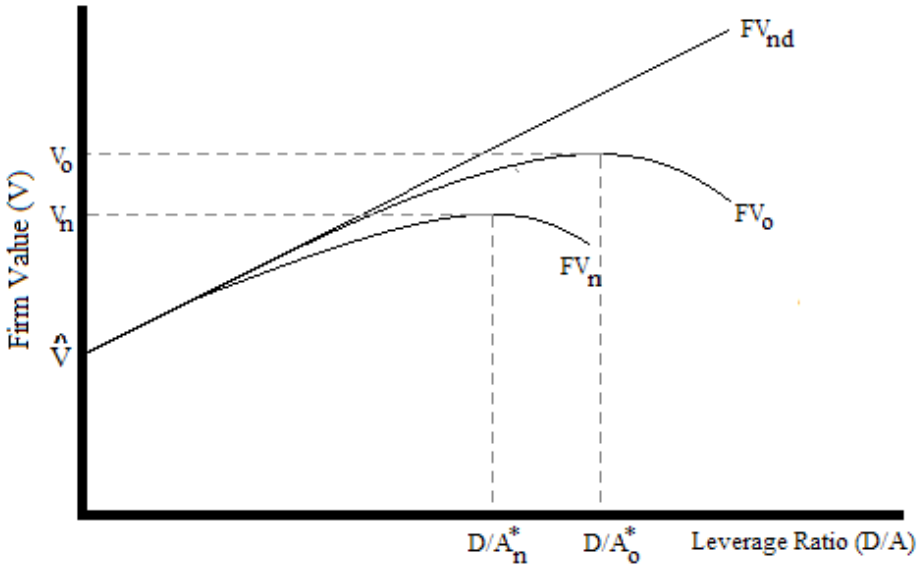

Figure 3.4: Trade-Off Including Radical Industries

Table 3.1: Data Summary

	IPO	Bond	IPO/Total	IPO ($ Mil)	Bond ($ Mil)	SB.Ratio
1970	16	187	0.079	48	9,397	0.005
1970.5	8	240	0.032	25	13,778	0.002
1971	22	251	0.081	109	13,686	0.008
1971.5	21	184	0.102	104	9,505	0.011
1972	34	225	0.131	118	10,336	0.011
1972.5	27	157	0.147	158	8,829	0.017
1973	14	140	0.091	727	7,118	0.085
1973.5	2	125	0.016	6	8,491	0.001
1974	1	169	0.006	2	13,170	0.000
1974.5	0	168	0.000	-	14,414	0.000
1975	0	252	0.000	-	22,073	0.000
1975.5	1	183	0.005	17	11,961	0.001
1976	6	181	0.032	72	16,374	0.004
1976.5	4	166	0.024	66	13,050	0.005
1977	5	147	0.033	80	12,747	0.006
1977.5	2	163	0.012	5	12,111	0.000
1978	1	154	0.006	26	10,947	0.002
1978.5	3	122	0.024	12	9,302	0.001
1979	6	129	0.044	38	13,077	0.003
1979.5	7	138	0.048	43	12,213	0.004
1980	8	206	0.037	63	21,710	0.003
1980.5	31	163	0.160	398	15,067	0.025
1981	40	423	0.086	360	25,063	0.014
1981.5	33	441	0.070	360	22,637	0.015
1982	8	402	0.020	52	20,109	0.003
1982.5	15	582	0.025	228	42,632	0.005
1983	57	552	0.094	1,553	38,240	0.038
1983.5	121	507	0.193	1,894	33,857	0.050
1984	40	422	0.087	673	34,487	0.019
1984.5	35	629	0.053	730	60,809	0.012
1985	36	684	0.050	692	58,270	0.012
1985.5	58	911	0.060	2,638	92,647	0.027
1986	83	931	0.082	2,573	124,712	0.020
1986.5	130	1087	0.107	5,764	148,183	0.036
1987	108	1023	0.095	8,652	127,891	0.060
1987.5	88	982	0.082	4,489	131,663	0.032
1988	57	1072	0.050	7,185	164,414	0.040
1988.5	55	1148	0.046	4,851	168,924	0.027
1989	54	1016	0.050	4,057	188,098	0.021
1989.5	67	1088	0.058	4,521	203,971	0.021
1990	66	857	0.072	4,870	160,651	0.029
1990.5	31	796	0.037	1,902	149,075	0.012
1991	76	878	0.080	4,063	227,327	0.017
1991.5	132	896	0.128	8,075	229,081	0.033
1992	160	951	0.144	11,220	334,536	0.031
1992.5	137	1089	0.112	6,246	307,170	0.020
Total	1906	23217	0.076	89,767	3,373,805	0.026

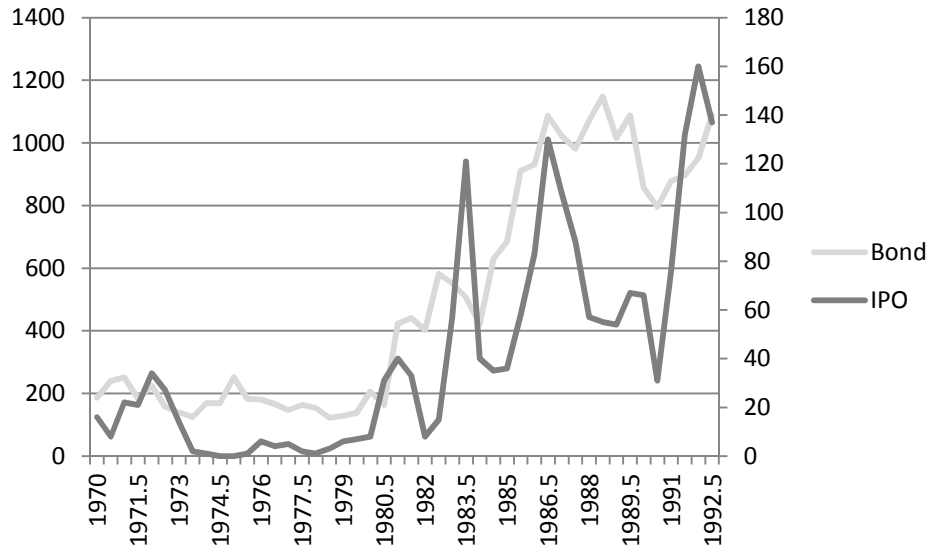

Figure 3.5: Bond and IPO Activity Over Time: Total

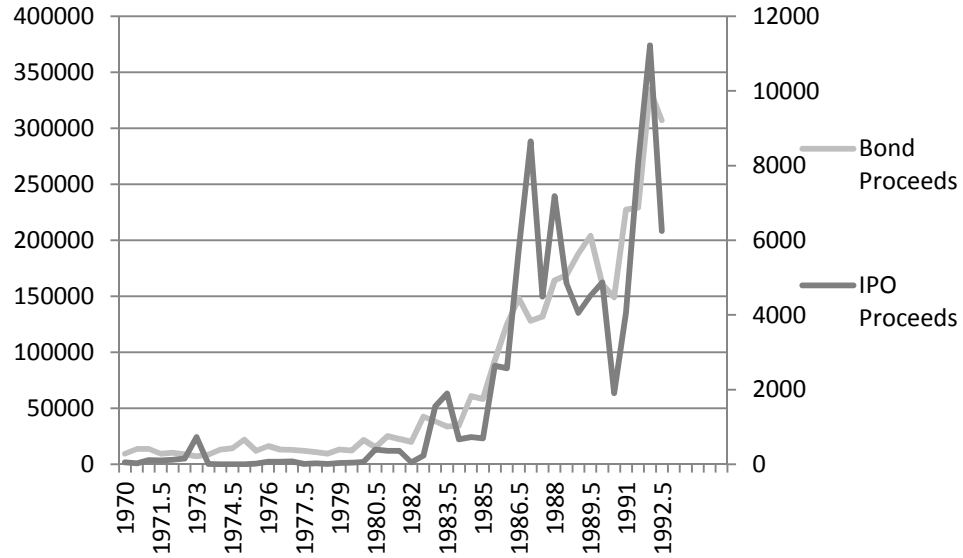

Figure 3.6: Bond and IPO Activity Over Time: Total $ Proceeds

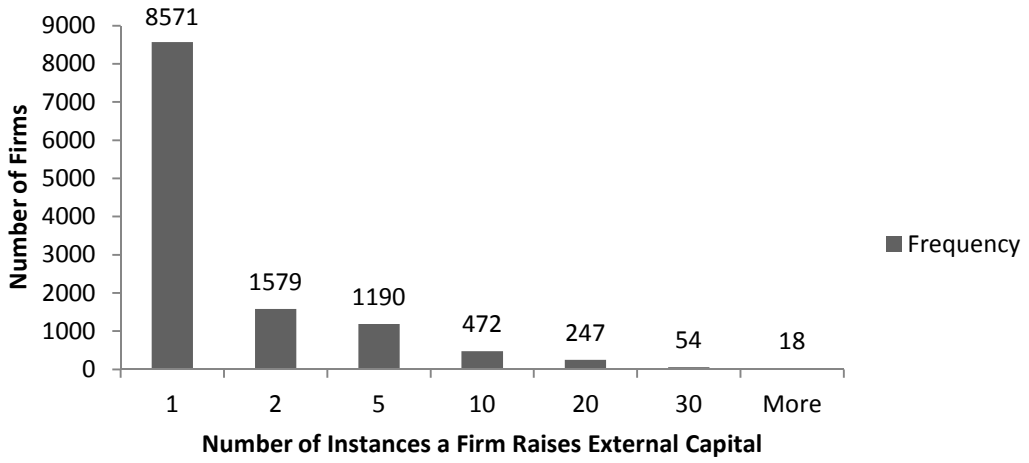

Figure 3.7: Fundraising

Table 3.2: Industry Fundraising and patenting

2 Digit Description	2 Digit SIC	N - Fundraising	Total Patents	SB.Ratio
Metal Mining	10	72	27,446	0.0452
Coal Mining	12	55	25,163	0.0000
Oil and Gas Extraction	13	712	169,446	0.0161
Mining and Quarrying of Nonmetallic Minerals, Except Fuels	14	32	77,015	0.1317
Building Cnstrctn - General Contractors & Operative Builders	15	115	65,057	0.0476
Heavy Cnstrctn, Except Building Construction - Contractors	16	35	188,841	0.1692
Construction - Special Trade Contractors	17	31	165,873	0.0254
Food and Kindred Products	20	451	117,569	0.0084
Tobacco Products	21	45	303,144	0.0262
Textile Mill Products	22	95	66,542	0.0810
Apparel, Finished Prdcts from Fabrics & Similar Materials	23	102	57,895	0.0898
Lumber and Wood Products, Except Furniture	24	87	107,909	0.0084
Furniture and Fixtures	25	46	121,546	0.0361
Paper and Allied Products	26	286	181,111	0.0098
Printing, Publishing and Allied Industries	27	238	184,377	0.0433
Chemicals and Allied Products	28	717	154,852	0.0426
Petroleum Refining and Related Industries	29	141	255,432	0.0164
Rubber and Miscellaneous Plastic Products	30	129	303,486	0.0443
Leather and Leather Products	31	40	95,174	0.1583
Stone, Clay, Glass, and Concrete Products	32	188	127,107	0.0249
Primary Metal Industries	33	284	165,381	0.0491
Fabricated Metal Prdcts, Except Machinery & Transport Eqpmnt	34	174	140,079	0.0192
Industrial and Commercial Machinery and Computer Equipment	35	594	181,631	0.0450
Electronic, Elctrcl Eqpmnt & Cmpnts, Excpt Computer Eqpmnt	36	516	178,845	0.0842
Transportation Equipment	37	452	182,126	0.0095
Measuring, Analysing and Control Instruments	38	364	91,135	0.0920
Miscellaneous Manufacturing Industries	39	105	118,926	0.0934
Railroad Transportation	40	476	165,350	0.0001
Local, Suburban Transit & Interurbn Hgwy Passenger Transport	41	31	60,309	0.0000
Motor Freight Transportation	42	85	94,728	0.1057
United States Postal Service	43	1	-	0.0000
Water Transportation	44	219	161,412	0.0484
Transportation by Air	45	472	142,258	0.0057
Pipelines, Except Natural Gas	46	82	140,025	0.0243
Transportation Services	47	132	35,600	0.0090
Communications	48	1159	183,199	0.0086
Electric, Gas and Sanitary Services	49	3516	70,720	0.0025
Wholesale Trade - Durable Goods	50	269	95,887	0.0374
Wholesale Trade - Nondurable Goods	51	197	73,732	0.0384
Building Materials, Hardwear and Garden Supply	52	54	90,321	0.0300
General Merchandise Stores	53	260	51,825	0.0156
Food Stores	54	244	102,351	0.0097
Automotive Dealers and Gasoline Service Stations	55	48	404,268	0.0296
Apparel and Accessory Stores	56	79	350,850	0.1713
Home Furniture, Furnishings and Equipment Stores	57	69	-	0.1759
Eating and Drinking Places	58	158	-	0.0504
Miscellaneous Retail	59	204	-	0.0485
Depository Institutions	60	3802	-	0.0075
Nondepository Credit Institutions	61	2019	-	0.0005
Security & Commodity Brokers, Dealers, Exchanges & Services	62	367	-	0.0107
Insurance Carriers	63	500	-	0.0628
Insurance Agents, Brokers and Service	64	46	-	0.0417
Real Estate	65	887	-	0.0021
Holding and Other Investment Offices	67	1691	-	0.2494
Hotels, Rooming Houses, Camps, and Other Lodging Places	70	234	-	0.0366
Personal Services	72	28	-	0.1038
Business Services	73	673	-	0.0751
Automotive Repair, Services and Parking	75	140	-	0.0066
Miscellaneous Repair Services	76	3	-	0.5210
Motion Pictures	78	104	-	0.0148

Table 3.2 continued: Industry Fundraising and patenting.

Amusement and Recreation Services	79	53	-	0.0452
Health Services	80	379	-	0.0652
Legal Services	81	18	-	0.0063
Educational Services	82	37	-	0.0452
Social Services	83	14	-	0.4453
Museums, Art Galleries and Botanical and Zoological Gardens	84	1	-	0.0000
Membership Organizations	86	49	-	0.0000
Engineering, Accounting, Research, Management & Related Svcs	87	212	-	0.0909
Services, Not Elsewhere Classified	89	3	-	0.0000
Administration of Environmental Quality and Housing Programs	95	1	-	1.0000
National Security and International Affairs	97	1	-	0.0000
Total		25,123	6,075,943	

Table 3.3: Data Description

Var Name	Description	Mean	Std Dev
S/B Ratio	Ratio of stock issuance to bond issuance for all public issuance 1970-1992. Computed as: total proceeds of stock issuance to proceeds from bond issuance plus stock issuance for each 6 month period. Binomial variable equal to one when the firm raises funds through stock market issuance and zero when through the bond market. Bond classifications included: Asset Backed, Convertible, High-Yield Corporate, Investment Grade Corporate, and Mortgage Backed. Source: Thomson Reuters SDC Database	n/a	n/a
PGrant	Granted patents over The six month time periods. Source: NBER Patent database, Hall, Jaffe, and Trajtenberg(2001)	1.838	2.336
Time	Time factor; used to control for the time trend of stock market issuance. Calculated as time period minus 1969, resulting in time periods ranging between 1 – 22.5	n/a	n/a
Ind. Return	Industry returns computed as a market return average 2-digit SIC industries over the six month time periods. Includes returns on all publicly held stocks in the United States listed on the NYSE, AMEX, and NASDAQ stock exchanges. Values listed as percentage. Source: CRSP US Stock Database.	0.037	0.257
Bus. Cycle	Dummy Business Cycle Variable equal to one when economy is in expansion and zero when a contraction. Source: NBER Business Cycle Dating Committee	n/a	n/a
10 YrTBill	Average 10 year T-Bill rate over each 6 month period and acts as the long run interest rate Source: WRDS	8.94	1.98
RF	Risk Free Rate (1 Month T-Bill), averaged over the six month time periods. Source: Fama French, WRDS	0.0059	0.0018
Mkt. Return	Average market (S&P 500) return over the 6 month period. Source: S&P 500	0.0095	0.0113
MKTRF	Excess return on the market as measured by a value weighted return of all securities minus the rate of return on one month T-Bills. Averaged over the 6 month period. Source: Fama French, WRDS	0.006	0.021
SMB	Small Minus Big = 1/3(Small Value + Small Neutral + Small Growth) - 1/3(Big Value + Big Neutral + Big Growth) Measured on the market averaged over the 6 month period. Source: Fama French, WRDS	-0.0004	0.013
HML	High Minus Low = ½(Small Value + Big Value) - ½(Small Growth + Big Growth) Measured on the market averaged over the 6 month period. Source: Fama French, WRDS	0.004	0.015
UMD	Momentum Indicator, averaged over the six month time periods. Higher value indicates that stocks are on the upward swing while lower value is the opposite. Source: Fama French, WRDS	0.0072	0.016

Table 3.4: Base Model

Ratio	1	2	3	4	5	6	7	8
PGrant	**0.046**	**0.046**	**0.045**	**0.045**	**0.046**	**0.045**	**0.044**	**0.046**
	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
	1.47%	1.38%	1.38%	1.31%	1.29%	1.35%	1.35%	1.38%
Bus.Cycle		**-0.110**	**-0.097**	**-0.135**	**-0.197**	**-0.140**	**-0.098**	**-0.146**
		0.067	0.066	0.070'	0.072**	0.068*	0.066	0.068*
		-1.55%	-1.36%	-1.85%	-2.74%	-2.00%	-1.36%	-2.11%
10Yr T-Bill			**-0.015**	**0.055**	**0.077**			**-0.008**
			0.014	0.028*	0.028**			0.014
			-0.38%	1.33%	1.83%			-0.20%
RF				**-88.419**	**-108.048**	**-40.408**	**-40.492**	
				29.0**	29.53***	14.99**	14.47**	
				-2.01%	-2.38%	-0.96%	-0.97%	
Mkt Return					**10.766**	**9.145**		**8.981**
					2.46***	2.43***		2.41***
					1.45%	1.33%		1.31%
Constant	**-1.526**	**-1.446**	**-1.323**	**-1.397**	**-1.550**	**-1.281**	**-1.217**	**1.441**
	0.039***	0.067***	0.143***	0.144***	.149***	.120***	0.118***	0.148***
Mean VIF	1.00	1.00	1.03	2.25	2.07	1.03	1.00	1.06

Bolded value is coef, 2nd is SE with stat significance, 3rd is 1 StDev change
*** significant at 0.1%
** sig at 1%
* sig at 5%
'at 10%

Table 3.5: Base plus Industry Returns

Ratio	9	10	11	12	13	14	15	16
PGrant	**0.047**	**0.046**	**0.045**	**0.045**	**0.046**	**0.044**	**0.044**	**0.045**
	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
	1.47%	1.39%	1.39%	1.31%	1.27%	1.33%	1.35%	1.36%
Ind.Return	**0.058**	**0.029**	**0.023**	**0.032**	**-0.135**	**-0.141**	**0.019**	**-0.140**
	0.066	0.071	0.073	0.068	0.127	0.128	0.073	0.132
	0.20%	0.10%	0.08%	0.10%	-0.41%	-0.46%	0.06%	-0.46%
Bus.Cycle		**-0.107**	**-0.095**	**-0.133**	**-0.215**	**-0.159**	**-0.096**	**-0.165**
		0.068	0.067	0.070'	0.075**	0.071*	0.067	0.071*
		-1.50%	-1.33%	-1.81%	-3.01%	-2.29%	-1.34%	-2.41%
10Yr T-Bill			**-0.015**	**0.055**	**0.077**			**-0.008**
			0.014	0.028*	0.028**			0.014
			-0.38%	1.35%	1.81%			-0.21%
RF				**-88.712**	**-107.734**	**-40.640**	**-40.396**	
				29.01**	29.37***	15.01**	14.49**	
				-2.02%	-2.36%	-0.96%	-0.97%	
Mkt Return					**11.690**	**10.125**		**9.971**
					2.677***	2.656***		2.663***
					1.57%	1.46%		1.45%
Constant	**-1.529**	**-1.449**	**-1.327**	**-1.404**	**-1.538**	**-1.270**	**-1.220**	**-1.430**
	0.040***	0.068***	0.144***	0.145***	0.149***	0.120***	0.119***	0.147***
Mean VIF	1.00	1.02	1.04	2.01	1.95	1.08	1.02	1.11

Bolded value is coef, 2nd is SE with stat significance, 3rd is 1 StDev change
*** significant at 0.1%
** sig at 1%
* sig at 5%
'at 10%

Table 3.6: Fama-French Estimations

Ratio	17	18	19	20	21	22	23	24
PGrant	**0.047**	**0.047**	**0.045**	**0.046**	**0.046**	**0.046**	**0.046**	**0.046**
	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
	1.38%	1.39%	1.36%	1.38%	1.37%	1.36%	1.36%	1.37%
Bus.Cycle	**-0.206**	**-0.122**	**-0.135**	**-0.110**	**-0.143**	**-0.154**	**-0.223**	**-0.212**
	0.072**	0.068'	0.069*	0.068	0.069*	0.071*	0.074**	0.072**
	-3.04%	-1.71%	-1.92%	-1.54%	-2.03%	-2.20%	-3.34%	-3.14%
MktRF	**7.254**						**7.962**	**7.924**
	1.467**						1.850***	1.850***
	1.92%						2.12%	2.10%
SMB		**5.093**			**4.420**	**3.443**	**-3.071**	**-1.917**
		2.392*			2.403'	2.586	2.980	2.816
		0.82%			0.71%	0.55%	-0.49%	-0.31%
HML			**-4.676**		**-4.177**	**-5.670**	**-1.764**	**-0.123**
			1.979*		1.973*	2.437*	2.677	2.214
			-0.92%		-0.81%	-1.10%	-0.34%	-0.02%
UMD				**0.189**		**-2.224**	**-2.450**	
				1.836		2.352	2.383	
				0.04%		-0.45%	-0.50%	
Constant	**-1.435**	**-1.440**	**-1.412**	**-1.447**	**-1.410**	**-1.380**	**-1.403**	**-1.435**
	0.067***	0.067***	0.069***	0.070***	0.069***	0.019***	0.078***	0.068***
Mean VIF	1.07	1.01	1.02	1.01	1.03	1.36	1.62	1.41

Bolded value is coef, 2nd is SE with stat significance, 3rd is 1 StDev change
*** significant at 0.1%
** sig at 1%
* sig at 5%
'at 10%

Table 3.7: Results Including Time Trend

Ratio	25	26	27	28	29	30	31	32
PGrant	**0.046**	**0.045**	**0.045**	**0.044**	**0.045**	**0.046**	**0.046**	**0.046**
	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
	1.48%	1.41%	1.41%	1.38%	1.37%	1.40%	1.40%	1.40%
Time	**0.013**	**0.012**	**0.011**	**0.010**	**0.007**	**0.009**	**0.008**	**0.008**
	0.0049**	0.005*	0.005*	0.0047*	0.005	0.005'	0.005'	0.005'
	1.05%	0.90%	0.87%	0.73%	0.51%	0.63%	0.63%	0.61%
Bus.Cycle		**-0.079**	**-0.070**	**-0.072**	**-0.117**	**-0.175**	**-0.172**	**-0.178**
		0.066	0.066	0.066	0.068'	0.072*	0.073*	0.072*
		-1.13%	-1.00%	-1.02%	-1.68%	-2.59%	-2.54%	-2.63%
10Yr T-Bill			**-0.011**				**-0.003**	
			0.014				0.014	
			-0.30%				-0.08%	
RF				**-35.260**	**-36.696**			
				14.65*	15.13*			
				-0.87%	-0.89%			
Mkt Return					**8.623**			**1.760**
					2.479**			3.045
					1.28%			0.26%
MktRF						**6.960**	**6.924**	**6.414**
						1.478***	1.505***	1.815***
						1.90%	1.89%	1.74%
Constant	**-1.750**	**-1.667**	**-1.560**	**-1.427**	**-1.430**	**-1.599**	**-1.570**	**-1.605**
	0.081***	0.095***	0.159***	0.142***	0.146***	0.098***	0.161***	0.100***
Mean VIF	1.00	1.02	1.03	1.03	1.06	1.08	1.09	1.30

Bolded value is coef, 2nd is SE with stat significance, 3rd is 1 StDev change
*** significant at 0.1%
** sig at 1%
* sig at 5%
'at 10%

Table 3.8: Reduced Sample

Ratio	33	34	35	36	37	38	39	40
PGrant	**0.048**	**0.048**	**0.048**	**0.046**	**0.046**	**0.050**	**0.051**	**0.049**
	0.011***	0.011***	0.011***	0.011***	0.011***	0.010***	0.011***	0.010***
	1.61%	1.61%	1.62%	1.56%	1.53%	1.61%	1.63%	1.60%
Time	**0.013**	**0.013**	**0.013**	**0.012**	**0.010**	**0.010**	**0.010**	**0.010**
	0.006*	0.005*	0.005*	0.005*	0.005'	0.005'	0.005'	0.006'
	1.28%	1.31%	1.31%	1.22%	0.93%	0.96%	0.95%	0.91%
Bus.Cycle		**0.013**	**0.010**	**0.017**	**-0.034**	**-0.090**	**-0.103**	**-0.094**
		0.074	0.074	0.074	0.075	0.080	0.080	0.079
		0.20%	0.16%	0.26%	-0.53%	-1.44%	-1.63%	-1.50%
10Yr T-Bill			**0.003**				**0.011**	
			0.017				0.017	
			0.11%				0.35%	
RF				**-23.850**	**-23.332**			
				16.940	17.323			
				-0.72%	-0.69%			
Mkt Return					**8.705**			**2.626**
					2.831**			3.504
					1.57%			0.47%
MktRF						**6.761**	**6.899**	**5.933**
						1.680***	1.704***	2.071**
						2.20%	2.21%	1.92%
Constant	**-1.762**	**-1.774**	**-1.803**	**-1.615**	**-1.621**	**-1.703**	**-1.800**	**-1.710**
	0.093***	0.107***	0.184***	0.160***	0.164**	.112***	0.186***	0.113***
Mean VIF	1.10	1.07	1.08	1.07	1.10	1.15	1.15	1.36

Bolded value is coef, 2nd is SE with stat significance, 3rd is 1 StDev change
*** significant at 0.1%
** sig at 1%
* sig at 5%
' at 10%

CHAPTER 4

PRIVATE CREDIT AND UNEQUAL ACCESS[5]

4.1 Abstract

Following the established relationship between financial development and growth, it is important to understand the elements that influence the efficiency through which capital is allocated. One such widely used measure is the private credit to GDP ratio; a higher number is indicative of more financial development and typically higher economic growth. The positive impact of information sharing and legal reforms on private credit is well established. I propose an additional element that influences the level of private credit—inclusive access to financial services. This can be measured in two ways: the first is the traditional definition as the percentage of the adult population with an account at formal financial institutions while the second is distribution of access among income groups

The newly released Global Financial Index database from the World Bank allows for the first time the ability to effectively test the impact of access; previous studies were forced to rely on crude measures of access as complete cross-country data were unavailable. I argue that these two measures of inclusiveness, total access and the

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equality of access, are positively related with private credit. I find significant evidence that the total percentage of people in the financial sector is associated with, and unequal access to finance leads, to a lower private credit/GDP ratio.

4.2. Introduction

The literature on the relationship between financial development and economic growth is vast, with many studies finding evidence that more financial development leads to faster growth. Because of the difficulty of directly measuring financial development, private credit/GDP ratio has emerged as the dominant proxy when estimating the relationship between finance and growth. This variable encompasses a number of different reforms that facilitate expansion of the level of credit within the economy. Addressing some of these reforms, Djankov, McLiesh, and Schleifer (2007) evaluate how information sharing and creditor rights affect private credit. They make a compelling case for increasing the strength of these institutions as priorities when contemplating policy reforms. I contend that in addition to these institutions, reforms should also target a more inclusive financial sector. There is a growing body of research that sees inclusive financial markets as being a critical element to economic development (Claessens, 2006; Cull, Demirguc-Kunt, and Morduch, 2013), positing that without access to financial institutions, income inequality will persist and result in slower economic growth.

An inclusive financial sector is one that services all members of society, not just the wealthy. The basic definition of access is whether people have the ability to open an account at a formal financial institution. There is a large and growing body of literature on the effects of access to finance; most of this surrounds immediate welfare gains,

contributing to the ideas of reducing income inequality, thus causing a country to grow faster. Without inclusive financial services, poor households are forced to rely on personal savings or kinship networks in order to become entrepreneurs or invest in household expenditures such as education, health care, and other emergency expenses. At the same time, small businesses are forced to rely on retained earnings if they are unable to raise funds using external capital. Most of the literature on inclusive finance focuses on increasing the total number of people in the financial sector. However, increasing the number of people with accounts does not necessarily mean inclusivity as the increases in accounts could purely belong to the wealthiest, excluding those at the bottom. For this reason, I have created an additional measure of inclusiveness that is defined as being a more equal distribution of access across income groups. Higher levels of inequality across income groups are indicative of higher barriers for the poor to have access to financial services.

The element of interest in this essay is related to the question of access. I hypothesize that inclusive financial sectors will increase the total amount of credit availability. I evaluate this based on two dimensions of access: the total amount of people involved in the formal financial sector and the equality of access to credit institutions. Increasing access is an element of financial development, with distinct policy changes that can be made just as for any other policies regarding other aspects of financial development. I empirically assess the relationship and will argue that the distribution of access among income groups is just as important as total access. Higher inequalities of access will lead to a lower level of credit in the economy, thus hindering the abilities of financial markets to be effective in stimulating growth. I hypothesize that

including the groups traditionally locked out of credit markets will lead to higher private credit.

Previously, these theories were not able to be tested as there was not adequate cross-country survey data on the number of people in the financial sector, and researchers were forced to rely on proxies that were admittedly crude. The recent emergence of the Global Financial Inclusion Database from the World Bank takes a step forward with detailed survey data on 158 countries. These data detail the percentage of people in the economy with an account at a formal financial institution. This paper is the first to use this complete dataset to evaluate the impact of access on financial development. I also contribute to the literature with the construction of an index of financial access inequality as a better measure of inclusiveness of financial markets.

This question of the relationship between access and private credit empirically follows Djankov, McLeish, and Schliefer's 2007 paper titled "Private Credit in 129 Countries." In that paper, the authors evaluate the traditional determinants of the effectiveness of financial markets: legal rights, legal origins, and information sharing. Their results suggested that private credit levels were higher in countries with more effective transfers of information and legal systems that provided more rights to creditors. These results suggested that financial systems were more effective in the landscapes providing these elements, encouraging those with capital to increase their supply of funds to the market. My estimations use the same model specifications and data as Djankov, McLeish, and Schliefer, with the only difference being updated data and the inclusion of the two measures of financial inclusiveness. The private credit ratio is regressed on the measures of inclusiveness, total access and inequality of access, controlling for the other

institutional and market factors. The econometric results are straightforward; I find significant evidence that inclusive financial systems are associated with increasing private credit ratios. These results hold for both the total amount of access and the distribution of access across income groups.

4.3. Theory and Review of Literature

A large and thorough literature has emerged on the abilities of financial development to promote economic growth; while there is a substantial amount of literature countering that financial development exhibits negative effects on growth, the majority of existing literature finds a positive relationship. Some of the more recent literature on financial development evaluates its effects on poverty and inequality. Within financial development a number of different types of reforms can be implemented; determining which of these reforms have the greatest impact on the efficient allocation of capital will shed light on helping some countries institute the most appropriate policies in their individual circumstances.

Building on the early theoretical literature on the effects of financial development and growth, a number of empirical studies have emerged beginning in the early 1990s. One of the earliest and most prominent is that of King and Levine (1993), which supports the view that financial development positively influences growth, controlling for other factors that affect long-run growth. This study focused on banking variables, including credit to the private sector divided by GDP, to proxy for the level of financial development, and setting the dependent variable as economic growth. These early studies did a poor job of correcting for endogeneity; the assessment of causality was the

way cross-sectional regressions were set up and concluding that the explanatory variables caused changes in the dependent variable. In order to correct these endogeneity issues, the use of instrumental variables opened the possibility of testing for endogeneity. These took the form of a country's legal origins as introduced by La Porta, Lopez-de-Silanes, Schliefer, and Vishny (1997). Using a two-stage regression, legal origins are an ideal instrumental variable since they are uncorrelated with growth, yet have a defined impact on financial development; these legal origins and the laws associated with them have shown to be influential in explaining a portion of the variation in financial development between countries. When using these instrumental variables, Levine, Loayza, and Beck (2000) argue for the use of the variable we now know as private credit/GDP ratio. This measurement is the total value of credits by financial intermediaries to the private, removing all other credits issued by the monetary authorities as used by King and Levine (1993). Levine, Loayza, and Beck estimate the relationship between private credit and growth using a panel model, finding that stronger creditor protections can boost financial development and economic growth. Beck, Levine, and Loayza (2000) extend this work attempting to determine the relationship between private credit and other sources of growth, including capital accumulation and productivity growth. Their findings show similar results to those used in pure cross-country regressions. A complete survey of the finance-growth literature can be found in either Ang (2008) or Demirguc-Kunt and Levine (2008).

While the majority of literature finds a positive relationship between financial development and economic growth, there exists a substantial amount of literature expressing skepticism. For example, Ram (1999) uses a sample of 95 countries, finding

that the correlation is weakly negative or negligible. A number of other studies have been able to show that causality does not always run from finance to growth, with the direction of causality also running in the reverse direction (Demetriades and Hussein, 1996; Arestis and Demetriades, 1997; Ang and McKibbin, 2007). These results provide support for Joan Robinson's contention that finance does not lead growth, but rather that financial systems act in response to economic conditions. As the economy is expanding, firms and households will have more demand for financial services, which will be provided by profit-seeking financial institutions (Robinson, 1952). Extending the research contesting that financial development may not be the gateway to growth, Rousseau and Wachtel (2005) examine the relationship between financial depth and economic growth using cross-sectional and panel data for 84 countries between 1960 and 2003. The three different measures of financial depth used (including credit to the private sector as a percentage of GDP) did not present as robust of findings as those from the 1980s and 1990s. Their principle finding is that while the relationship may have existed through the early 1990s, it appears to have diminished in the later periods; their conclusions were to act as a reminder that the correlations between finance and growth may well represent cross-country differences rather than a causal relationship.

One of the few variables to provide a conclusive relationship with growth is the proxy private credit to GDP. On the heels of the studies finding that private credit is positively associated with growth, a number of other studies have emerged to determine the impact of financial development on other factors. Beck et al. (2007) find that financial sector development reduces poverty and inequality, using private credit as their primary explanatory variable. The relationship between private credit and poverty is

evident, yet the estimations performed by Beck et al. do not adequately control for endogeneity, nor do they control for levels of development. Other studies on inequality and financial development include Nikoloski (2012) that uses private credit to proxy for financial development to test for the presence of a financial Kuznets curve. Outside of its association with growth, private credit also has been used to test the impact of increased development on industry level investment. Wurgler (2000) finds that when the level of credit increases, higher levels of industry investment occurs than countries with less developed financial markets are able to deliver. This result holds when controlling for legal rights, information transfers, and the extent of state ownership in the economy. Private credit is also used for evaluating the relationship between liberalization and financial development. Proponents of liberalization contend that foreign banks are better able to take advantage of economies of scale and geographically diversify their risks, leading to higher societal well-being. However, in one such study, Detragiache, Gupta, and Tressel (2006) contend that local banks are better able to assess the risks of marginal investment opportunities and will lend more. Empirical results show that, ceteris paribus, countries with more foreign bank penetration will have lower levels of private credit. As each of these studies should make clear, the use of private credit to proxy for financial development is widespread, but they do not address the underlying conditions that improve or weaken private credit. The determination of these underlying institutional factors is what is important in order to effectively implement financial reforms.

Of the specific financial reforms that influence private credit, information sharing and creditor rights' impacts are the two to receive the most attention. Their impacts on private credit were evaluated by Djankov, McLiesh, and Schleifer (2007), who find

statistical significance on each. Information sharing is based on the idea that without adequate information, lenders are unable to adequately assess risk and will ration credit. Creditors' rights is an evaluation of how easy it is for creditors to be able to get their funds back in the event of default. The theory postulates that the easier it is for creditors to seize their collateral, the more likely they will be to make loans, thus shifting the supply schedule to the right. The third factor they do not discuss, and the focus of my research, is access to credit. Creating an inclusive financial sector will lead to higher levels of credit in an economy. A theoretical exposition of the information sharing, creditor rights, and access to credit follows.

4.3.1. Information Sharing

Stiglitz and Weiss (1981) present the first theoretical justification for credit rationing. Basic economic theory posits that market equilibrium is where supply meets demand; as prices rise, lenders should supply more funds at a higher interest rate. However, within financial markets, there exists an excess supply of loanable funds as lenders ration credit. Banks care about two things: risk and return. As risk increases, the banks are induced to loan at a higher interest rate in order to compensate for the risk. A problem arises when interest rates rise for risky projects as the rate itself may influence the riskiness of the project. Banks, therefore, are aware of the "lemons" problems in which those who would borrow at the highest interest rates may be worse risks; the interest rates would not be able to act as a screening device, keeping bad investments out. Without adequate information as to the riskiness of borrowers, lenders will ration their available loanable funds, leading to a lower level of credit in the economy.

Stiglitz (1990) presents a theory on the effectiveness of peer monitoring in credit markets. Following the theory that information problems prevent lenders from distributing funds, Stiglitz suggests that the idea behind peer monitoring is that others are required to pay a penalty in the event that the borrower defaults. This is the basic function of, and premise behind the use of, microfinance institutions. Traditional lenders will typically not extend credit in small amounts because the cost of acquiring information is too high relative to the return received; peer monitoring is a situation where a certain amount of funds are allocated to a defined group who are responsible to determining the credit worthiness of a borrower. In the event that the borrower defaults, the rest of the group are penalized, which is adequate incentive for the members of the groups to do their due diligence. Loan repayment under peer-monitoring appears to be successful in terms of repayment with loan repayment rates near 100% in Bangladesh (Collins, Morduch, Rutherford, and Ruthven, 2009). The model presented by Stiglitz shows that peer monitoring leads to a transfer of risk and that this is, effectively, a net benefit to the borrowers. Transferring the risk removes some of the elements of adverse selection and should lead to a more efficient and effective financial sector.

Some of the adverse selection problems can be alleviated through government intervention, as argued by Stiglitz (1994). He posits that effective government regulation can reduce market failures and the problem of credit rationing. One such policy advocates for the government to keep interest rates low and, if necessary, below the market determined price as this can raise the average quality of borrowers; lowering interest rates would not increase the risk of default as associated with high rates and

credit rationing. Increasing government oversight in this manner would necessarily increase the private credit ratio.

4.3.2. Creditor Rights

The existence of the creditor power is based on a set of policies determined to contribute to credit market development. Poor countries tend to have poor legal systems and protections for creditors, thereby lowering the desire to make their capital available. Supporting the notion that investor protections are key to effective capital markets, La Porta, Lopez-de-Silanes, Schleifer, and Vishny (1997) introduce a possible explanation of why some countries have larger capital markets than others. This hypothesis is based on the legal origins of countries; countries with French civil law origins have fewer investor protections than countries with English common law origins. Much of the data on investor rights can be traced back to this influential work on financial development. Lopez de Silanes, La Porta, Schleifer, and Vishny (1998) expand these classifications by including the Scandinavian and German legal origins and find a strong relationship between these legal origins and depth of the financial system. Levine (1998,1999) evaluates the impact of these legal origins on the level of bank development as constructed by Levine and Zervos (1998); this measure was the precursor to the private credit variable by the value of loans to the private sector divided by GDP and is a narrower variable focused primarily on the banking sector. Levine finds that stronger legal protections are associated with a deeper banking sector, which is then associated with per capita GDP growth, capital accumulation, and productivity growth.

Expanding the legal system argument, Demirguc-Kunt and Maksimovic (1998) find that in countries with efficient legal systems, as identified by an index of legal efficiency, a larger number of firms use long-term external capital. Extrapolating from these findings, firms are able to grow faster since they had more access to capital than they otherwise would have been able to do if they had to rely solely on retained earnings. These results are robust and lend credence to the idea that efficient creditor laws promote increased credit expansion. A stronger legal system is associated with more rights afforded to creditors and typically means more efficient financial services. Djankov, McLeish, and Schliefer (2007) find substantial evidence that the level of creditor rights are positively associated with the level of private credit in the economy. Explanatory variables in this study are a constructed index of creditor rights, the number of days it takes for a payment contract to be settled by the courts, and a country's legal origins.

4.3.3. Access to Credit

The early theoretical research on financial markets posited that their purpose was the efficient transfer of funds from savers to borrowers (Gurley and Shaw, 1955; McKinnon, 1973). In order to increase investment, the contention is that it is necessary to increase the amount of savings that could then be channeled into productive projects. Part of the theory of finance is that increasing the number of participants in the financial sector promises to increase capital stock; the policy advice extended from this is that increasing access to financial services will attract more individuals to place their savings in banks. This influx of funds would then be able to be lent out, increasing the rate of growth in the economy.

Increasing information and creditor rights are policies targeting increasing the supply of loanable funds in order to entice those with surplus funds to save, thus discouraging credit rationing. Information and legal constraints have been discussed widely in the literature as to their impacts on access. One of the most pressing obstacles for individuals and firms to overcome is due to the cost of financial services being too high. The costs to financial institutions to administer their services does not change much between servicing poor or wealthy households; as such, the poor are faced with a higher percentage of costs for using the bank services. Because of the low amount of funds deposited or withdrawn by the poor, banks are reluctant to provide the services needed by some segments due to low levels of profitability. Attempting to lower the costs of administering financial services to the poor, a consortium of banks in South Africa created a new type of account with fewer services, yet much lower cost, than a traditional account (Napier, 2006).

Because of the need to reduce the costs of administering traditional bank accounts, services like these are effective in increasing the number of people in the financial system. Another obstacle to providing services at a low cost is related to geographical concerns; banks are especially reluctant to expand financial services into areas with low populations or are difficult to access as they would face high transactions costs for small volumes of loans. The rise of smartphones across the globe has given rise to providing mobile banking services. Mallat, Rossi, and Tuunainen (2004) present a convincing argument for the deployment of mobile banking services that would allow people the ability to use banking services without ever setting foot into a bank by using cell phone applications. The benefits are that the services are almost completely

automated and that throughout the developing world, even in the sparsely population regions, cell phones have had widespread penetration. The widespread impact of mobile banking has yet to run its course, so only time will tell if this is an effective means of reducing access problems.

Another significant obstacle to finance include burdensome documentation requirements; these are especially prevalent in poor countries as banks will typically require state issued documentation in order to open an account and many of the poor citizens of the country not employed by the formal sector lack any such papers. Other barriers include lack of trust in financial services and religious considerations. A review of the access to finance literature can be found in Claessens (2006). These problems are able to be overcome although it may take some governmental programs to create incentives for banks to pursue the poorer populations.

Attempting to overcome the barriers to finance identified above, the advent of microfinance has become an important mechanism through which many have been brought into the formal financial sector. Within microfinance (and more specifically microcredit), banks will transfer some of their monitoring and information costs to a defined group of members; in these groups, penalties are assessed on individuals if other members of the group default on a loan. Therefore, it is in the groups' best interest to monitor others in order to continue to be able to receive loans for their purposes and reducing the costs to the banks. This is one scenario within a number of other structures of providing small loans. The hope was that providing these financial services to the poor is a win-win scenario in that the poor will be able to access financial services to help themselves out of poverty while providing additional profits to the banks providing these

loans. Microfinance has had its successes and failures, as highlighted early on by Morduch (1999) where he shows that loan repayments were above 95% in many localities, but that bureaucratic expansion and corruption dampen the progress that could be made. What is undeniable is that large percentages of the population considered unbankable have been provided an avenue for entrance into the formal financial sector. De Aghion, Armendariz, and Morduch (2007) provide a thorough examination of the microfinance revolution, the widespread hope of poverty alleviation, and a series of puzzles often overlooked. Banerjee, Duflo, Glennerster, and Kinnan (2013), using data from a randomized evaluation of slums in India, find significant results that once microfinance institutions entered slums, the percentage of people using the loans rose dramatically and that loan sizes were larger. Their results also suggested that while access to finance rose, there was no difference in household consumption and that the average business was no more profitable. The result that microfinance does not appear to influence any of the development indicators are in line with much of the recent literature on microfinance; some of this can be attributed to the sentiment that many microfinance organizations are no better than the village loan sharks, making large profits off the poor (Bannerjee, Duflo, Glennerster, and Kinnan, 2013).

It is also important to distinguish between access and use. Access is typically defined as the availability of a supply of quality financial services, while use refers to actual consumption. The difference between access and use is attributed to voluntarily excluding themselves from financial services because of not having a need or costs being too high. Because of the great difficulties in empirically separating those who voluntarily do not use financial services, this analysis will consider both access and use in the same

regard. For our purposes, the distinction between the two is not important; any situation that inhibits the poor's ability to open an account is akin to access limiting.

4.3.4. Total Access

Creating an inclusive financial sector by expanding access is applicable for all economies, rich and poor; having more widespread access to financial services increases opportunities and helps a country to realize its full potential. There are two trains of thought in regard to financial markets in modern development theory. The first addresses the abilities of financial markets to fund the poor's profitable projects. The second is the capital accumulation theory in which increased access brings more people/firms into the formal financial sector; without their inclusion in financial markets, there is less borrowing for increasing households' human or physical capital. When people save through a formal institution rather than putting the excess under their mattresses, the total amount of loanable funds will rise. In addition to this, the ability to earn an interest rate on their savings (even though it might be small) can entice savers to hedge against some inflation risk, giving another boost to lendable funds. Without access, less savings get mobilized for productive uses.

Whether potential entrepreneurs will leave their current employment is dependent on their abilities to save and their access to external capital. Financial market frictions can contribute to projects never being funded, reduce private credit, and help to perpetuate continuing inequalities. Galor and Zeira (1993) evaluate the link between frictions and investments in human capital with findings that the poor are unable to, or will not, invest in their future well-being. This is a result in which welfare and private

credit are both reduced even in the presence of a positive present value of investing in future benefits such as education.

The question arises as to whether the optimal policy is to increase access to firms or to households. One of the critics of the microfinance movement, Karnani (2007), posits that while microfinance may bring more people into the financial sector, targeting larger enterprises is a more effective policy for eradicating poverty. Karnani hypothesizes that these large enterprises are better job creators and will help the plight of the poor better than extending credit to the poor for consumption or entrepreneurial purposes. However, as Yunus (1999) contended when introducing modern microfinance, enabling the poor to finance themselves has immediate positive welfare implications that do not rely on jobs "trickling down." Setting aside welfare for a moment and looking exclusively at the impact of access on private credit, it should be evident that increasing access at any level will result in higher levels of credit. Attracting more firms and/or households and bringing them into the financial sector will increase both the supply and demand for credit. The only situation where increasing access might not increase credit is if one group's increase came at the expense of another. An example would be a policy that shifted incentives from providing large firms with credit to providing loans to the poor, which was accompanied by a significant drop in the availability of funds for larger firms. This would result in the costs of expanding access coming at the expense of established firms, which would result in a net loss to society. In this case, careful evaluation of policies is paramount. Well-intentioned policies may actually hurt those they are attempting to help.

Attempting to answer some of the questions surrounding access, Honohan (2006) produces new estimates for the level of access to financial services, finding that across countries access is negatively correlated with poverty. Honohan posits that the relevant concern for poor households is not how many financial assets are held, but rather whether they have access to financial products at all. Conclusions of this research are that deposit products are used first as a country develops; after that, more sophisticated credit instruments have the potential for helping. This would imply that it is important to develop wider availability of credit instruments first.

Combined with efficient information transfers, financial intermediaries' ability to evaluate firms' investment projects can lead to higher growth as entrepreneurs are able to expand through lower interest rates and better terms. Tobin and Brainard (1963) provide a theoretical basis for this proposition in that when there is adequate information, more capital is available and the available funds can then be channeled into the most productive projects. When there are larger inequalities of access, those in the higher income groups may have better credit terms while the lower income groups are still constrained by high information costs and are forced to accept worse terms—if they are even able to receive credit.

The differences in terms afforded to prospective borrowers can result in a number of profitable and socially beneficial projects to never be funded. High returns are typical of many of the poor's entrepreneurial decisions, yet represent relatively small investments that are not attractive to those with higher income/wealth. That many of these projects get funded with incredibly high interest rates is indicative of these high returns as it can be assumed that the entrepreneurs would not be borrowing unless their

projects will return more than the interest rate. If the poor had the same level of access to financial services and terms as those in the upper income groups, there would be significant increases in private credit.

4.3.5. Unequal Access

Apart from increasing the total level of access to financial services, there exists the notion that the distribution of financial services between income groups is also important. In societies with a larger dispersion of financial services between the rich and poor, there will be larger disparities of income and wealth, upon which the level of financial development also depends. Distribution matters; there are distinct policy decisions made that influence who has access to finance. Some financial services, such as derivatives, are not directly useful for the poor whereas other financial services, such as microcredit, have no relevance for the wealthy.

One train of thought is that distribution among income groups does not matter; the only thing that matters is that those in need of the largest amounts of capital have access as they are the drivers of growth which would then trickle down to the poor. This would be an argument for first targeting the wealthy; they have the wealth that can be used as capital by those who require it. Following this, it would then make sense to increase access from the top down. Setting welfare aside for a moment and assuming that increasing the level of credit is the only goal, it would make no sense to even target the poor. This would presuppose that credit is supply driven and that the goal is to increase the amount of funds deposited in the financial system. This supply of funds argument would posit that the optimal policy would be to bring the wealthy in first, then the upper

middle class, and on down. The only time to bring the poor into the formal financial sector would be after everyone above them has had access. This argument would necessitate that the distribution of access among income would be highly unequal—all at the top and nothing at the bottom.

My position is the exact opposite; higher inequality of access leads to a lower level of private credit. While this analysis does ignore welfare implications of access to credit, a total exclusion of the poor can contribute to persistent income inequality and poverty. From a supply perspective, it is important to increase access at the top to take advantage of wealth holders, but I argue that the distributional effects on demand are just as important. Bringing the lower income groups into formal financial services opens up a number of possibilities. Because the poor by definition have little income and savings, when they want to engage in entrepreneurial activities, they need access to credit. Locking them out of credit markets will eliminate many of the potential loans and productive projects being undertaken. Even if they are not output increasing, these loans to the lower income groups will add to private credit.

There has been a shift in the literature from the label "microcredit" to "microfinance" in response to expanding financial services outside of only providing credit to businesses. Providing microfinance in the form of credit, savings, and insurance to poor households is also affected by the level of access they have to financial services. Regardless of whether the poor live in a rich or poor country, they can have erratic income and consumption. This is especially true in developing countries where there is a high dependence on agricultural products. Rosenzweig (2001), in examining savings decisions, finds that poor households are engaged in significant amounts of borrowing to

smooth their consumption. Although it might not be output increasing, credit is largely used to smooth consumption over the year rather than over the lifetime; most of this saving is precautionary in order to pay for unexpected events.

On top of this is the idea that poor households engage in borrowing in order to handle emergencies. As an illustrative example, suppose there are two individuals in the same country, one poor and one wealthy, and they both experience a medical hardship. The wealthy person may be able to fund the entire medical procedure out of personal savings while the poor person with inadequate savings would be resigned to borrow to finance the emergency. If there is access to formal financial systems, the poor person's medical expenditures will increase private credit while the wealthy person's will have no impact. Conversely, if the poor person is locked out of formal credit, he or she might look to kinship networks to borrow the necessary funds; this borrowing is outside the formal measure of credit and would not be counted as lending. The interesting result of this is that kinship network borrowing will not increase the private credit/GDP ratio. In fact, it is actually more likely to *reduce* private credit. This is the case if the informal borrowing results in lenders removing funds from their savings account, which leads to a reduction in supply of loanable funds.

Among income groups, there are differing times an entrepreneur will seek external capital. Lower income groups have a higher marginal propensity to invest where there are a number of projects that would be left untouched by the wealthy because of their low absolute returns, yet are, I postulate, an inverse relationship between income and the propensity to invest. Galor and Zeira (1993) present a theoretical macroeconomic model showing that in the presence of capital market imperfections, initial distributions

of wealth can have serious repercussions for growth. These capital market imperfections are attributed to the poor not undertaking investments with high MPIs due to the inability to obtain capital. When people become wealthier, they are more likely to not undertake projects with low absolute returns or to finance them solely out of pocket, not even seeking external capital. If there is a project with a low initial investment, the wealthier person will be able fund it out of pocket but the poorer person will require external funds. In the first instance, funding out of pocket, this activity will reduce private credit as it is taking money out, whereas the second instance necessarily means an increase in private credit.

Entrepreneurial activities are not constant across income groups. The projects undertaken by the poor are typically too small for the wealthy to concern themselves with. The financial return for these small projects, however, is quite large as displayed by the extremely high rates of interest paid by the poor to get their projects off the ground. The size of the investment typically will be much too small for the wealthy given the number of headaches associated with a project of that size. Wealthier people typically will engage only in activities that have higher absolute payoffs and may eschew some higher rates of return because the absolute return is not worth their time. Where this might be too small for the wealthy, the absolute return may be high enough for those in lower income groups. In the poorest groups, enterprising individuals will borrow small amounts to give themselves a job, such as for basket weaving materials; in a wealthier bracket, the entrepreneur will either not bother with this investment because of its small size or will finance it through savings. It is then expected that bringing more of the poor population into the financial system will stimulate demand for capital, thus

increasing private credit. If this is the case, the distribution of credit access should be geared more toward bringing the poor access and reducing unequal access.

I hypothesize that inclusive financial sectors will lead to higher levels of credit in the economy. Within an inclusive financial system, I propose that there are two ways in which to measure access. The first is the traditional definition as the percentage of the adult population with an account at formal financial institutions, while the second is related to the distribution of access among income groups. If the level of account holders between groups is the same, the financial system can be regarded as being inclusive, regardless of the total access within the economy, as people are able to engage in financial services if they so desire. I argue that these two measures of inclusiveness, total access and the equality of access, are positively related with private credit.

4.4. Data

In order to test for the impact of access and the distribution of access on private credit, a dataset has been assembled to control for other confounding factors of financial development. The structure of the estimations contained herein directly follows the specifications as set forth in Djankov, McLiesh, and Schleifer (2007). The only difference in my model is that I am inserting variables on access to financial services. These data include a newly constructed variable on the distribution of access. Control variables include proxies on creditor rights, information sharing, and other market factors. There are 120 countries included in my sample, 64 of which are classified as "rich" and 57 as "poor" according to World Bank classifications. Countries that have been removed from the sample are those that did not have any observations for private

credit or level of access. Complete data descriptions are found in Table 4.1, and complete data in Appendix A.

4.4.1. Dependent Variable

My dependent variable, private credit to GDP ratio (private credit), is the total amount of credit relative to the level of GDP in the country. Being one of the most widely used variables as a proxy for financial development, understanding the underlying elements of this variable is of utmost importance. I use an average of the total amount of credit lent for the time period 2007–2011, averaging over a 5-year period as given in Djankov, Mcliesh, and Schleifer (2007). This variable refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits, and other accounts receivable that establish a claim for repayment. This amount is then divided by domestic GDP. Private credit estimates range between a low of 4.55% of GDP for Chad to a staggering 215% in Ireland with an average of 52.6% for the entire sample. Just over half (67/120) of the countries in the sample had private credit ratios between 25% and 125% of GDP. Falling outside this range, only 14 had private credit ratios above 125% and 38 countries had private credit ratios of less than 25%. As is common in the literature, the logarithm of private credit will be used.

4.4.2. Access Variables

Previously, researchers had to rely on other proxies of access, which were subject to the same type of criticisms associated with the use of financial development proxies. Prominent proxies of access include the number of ATMs per capita, distance to a bank

branch, and number of accounts relative to population. Of these, the best to emerge was the number of accounts; yet it too proved to be a flawed proxy. This is attributed to the fact that some individuals may have more than one account and some accounts can be held by foreigners. These levels can differ between countries and can contribute to some unobserved variation. However, the use of these variables was all that was available until recently. New estimates on access were provided by Honohan (2006), but a complete cross-country survey of access was not conducted until the release of the World Bank Global Financial Inclusion (FINDEX) database. This ambitious undertaking collected survey data from 158 countries and should allow for a better tracking of indicators in the future. Within the FINDEX dataset, it is made clear that access refers to the supply of services, while use is the demand for services. I have used the term access throughout to refer to both the supply and demand for financial services. The data on total access are from 2011. Survey collection was performed by Gallup, Inc, including more than 150,000 adults across the world. Their sampling methodology is randomly selected representative samples that reportedly cover 97% of the world's population over the age of 15. The complete sampling methodology can be found in Demirguc-Kunt and Klapper (2012).

I measure access to credit in two ways. The first is by using the traditional method of measuring the number of people with an account as a percentage of the population. The second, and most important for this research, is the inequality of access based on a computation of my own with data sourced from the FINDEX database. This is a constructed variable measuring the differences of access across income groups with higher values indicating more inequality between income groups.

4.4.2.1. Total Access

The main variable (*access*) represents the percentage of the adult population over the age of 15 with an account at a formal financial institution. A formal institution is defined as a bank, credit union, cooperative, post office, or microfinance institution. Having an account in one of these institutions is a stepping stone to more sophisticated financial products; it cannot be expected that someone will be able to secure a loan from a bank before having opened an account. According to the theory described above, increasing the level of access should increase the level of private credit through the mobilization of capital. This relationship is displayed in Figure 4.1. On the vertical axis is the logarithm of private credit and the horizontal shows the logarithm of access from low to high.

As the literature on total access to credit is vast, the inclusion of the total access variable does not have a great contribution to the literature. The main impact of the use of this variable is derived from the new survey data to confirm the impact of including a larger percentage of the population. Theory says that increasing the level of access should lead to higher levels of credit in the economy, yet there is a possibility of endogeneity since it is possible that higher levels of credit in an economy will enable more to be actively involved in the financial sector. While causality most likely runs from access to credit, the current data availability does not allow for convincing causal empirical estimates. The aim of including this access variable is to show a definitive relationship, rather than causality.

4.4.2.2 Unequal Access

Where the total level of access is an emerging focus of research, the main contribution of this paper lies in the formulation of another measure of financial inclusiveness—the equality of access according to income. Within the new FINDEX database, access is broken into income classifications that allow for the construction of an inequality of access index. In order to test the hypothesis of whether the distribution of access matters, I am using two variables from the FINDEX database and transforming them into a measure of unequal access. These two variables are *upp.60*, which is the percentage of people with incomes in the top 60% with an account at a formal financial institution, whereas *low.40* is the percentage of people with incomes in the bottom 40% with a formal financial account. I have then transformed these variables into a percentage difference, as defined below.

$$Ineq.Access = (upp.60 - low.40) \quad / \quad [(upp.60 + low.40) / 2] \tag{4.1}$$

If identical absolute differences exist between two countries, say 30% for the upper group and 20% for the lower in one country versus 50% to 40% in another country, they would have different *ineq.access* values. While the two countries will have a 20% disparity between groups, the first country would have much higher inequality: 0.40 compared to 0.22. This variable is not a perfect metric of the equality of access; a better method would be to compute an inequality metric using a Lorenz curve like a GINI coefficient. At this time, however, the dataset does not have individual incomes and does not allow for a computation in this manner. The use of my variable does display the

difference between the wealthier and poorer income groups. Where this variable differs from the total access variable is that even as total access is lower in poor countries, the level of unequal access does not depend on total access. Some countries can have sophisticated financial systems that are inclusive of the wealthy but neglect the poor, whereas others can have rudimentary financial markets that include similar percentages of the population across classes. What are important are the policies and underlying characteristics of the financial systems and whether they are inclusive or exclusive. The relationship between private credit and unequal access is displayed in Figure 4.2; the logarithm of private credit is on the vertical axis with the inequality of access plotted along the horizontal axis. With higher levels of inequality being further to the right on the horizontal axis, there is a definite negative relationship between private credit and unequal access.

This is a direct test of whether distribution of access to financial services is important in the determination of private credit. There are three possible outcomes for this variable: i) it will be insignificant and indicate that the distribution does not matter, ii) it will be significant and positive showing that higher levels of access inequality lead to higher private credit and that it is primarily supply driven, or iii) it will be significant and negative, indicating that distribution is important and that increased inequality will lead to lower credit. Outcome (iii) will result in support of my hypothesis.

4.4.3. Control Variables

Djankov, Mcliesh, and Schleifer (2007) present empirical evidence as to the determinants of private credit. They propose that the amount of credit available is

determined by the two complementary channels: information sharing and creditor rights. These channels of influence must be controlled for in my regressions because the level of financial development can influence the level of access to financial services. The basic model structure and data layout in this essay follow the model selection of Djankov, Mcliesh, and Schleifer.

Information asymmetries can result in adverse selection and credit rationing (Stiglitz and Weiss, 1981); thus, increasing the flow of information can result in more efficient financial systems. Besides physically inspecting a prospective borrower's project, the most effective (and lowest cost) means of determining credit worthiness is through credit rating agencies. A public registry is a government sponsored credit, whereas a private bureau is a for-profit agency providing credit rating services for a fee. A public registry is a database of prospective borrowers' credit standing compiled by a public agency and distributed to financial institutions. A private bureau is a private for- or nonprofit firm that maintains a database as to the standing of borrowers in the financial system. Their primary role is to facilitate the transfer of information between lending institutions. Data on public registry and private bureau are collected from Djankov, Mcliesh, and Schleifer (2007) and are dummy variables equal to one if there is an agency and zero if not in 1999.

Regardless of whether there is a public or private registry of information transfers, the overarching idea is that when there is effective sharing of information, credit rationing will decline and more funds will be lent. The variable information sharing is a dummy variable equal to one if there exists either a public or private registry and equal to zero if a country has neither. The inclusion of both the aggregated information sharing and the

individual factors is to determine whether a specific type of information sharing agency is important or that just having a registry of some type is the important characteristic. Of the 120 countries in the sample, 97 have a bureau of some sort while only 19 have both a private and public registry.

The second traditionally associated element behind effective financial development is the protections afforded to creditors. The theory is that when creditors have more ability to seize collateral and/or receive a portion of their investment back after default, creditors will be more likely to extend credit to potential borrowers. The order of lineup in bankruptcy court and amount of time it takes to settle disputes play a considerable role in whether credit is made available. Theory postulates that creating higher creditor rights will result in less credit rationing even in the presence of asymmetric information.

The index of creditor rights (*Cred.Rights*) used in this study is the same employed by Djankov, Mcliesh, and Schleifer (2007). This index can take a maximum value of four, receiving one point for each of the four elements a country possesses. One point is received for placing secured creditors first in line for the proceeds of a liquidated firm in bankruptcy court rather than placing other creditors such as the government or workers before secured creditors. Another point is received if management is removed from a company undergoing reorganization. Requiring creditor consent in order for a company to reorganize rather than file for liquidation garners another point. One of the strongest points received is if creditors are able to seize their collateral immediately after the bankruptcy petition is approved and not subject to an automatic stay. Countries without any of the above provisions (weak creditor rights) will receive a score of zero whereas

countries with all of the above provisions (strong creditor rights) will have a value of four. Others will fall in between.

If creditors have to seize their collateral they would like to be able to do so as quickly as possible. The longer an asset is tied up with a company or person in liquidation, the higher the costs are for the creditor. Therefore, creditors will be more likely to lend to borrowers with marginal risks under systems with quick resolution of liquidation proceedings. If potential lenders know they will have to wait a considerable amount of time to receive their collateral back, they will be reluctant to provide loans to questionable borrowers. The variable, contract enforcement, is defined as the amount of time it takes the court system to resolve a dispute over payment. Data are computed only for debt contracts that are larger than 50% of per capita GDP and come from Djankov, Mcliesh, and Schleifer (2007). Length of time to enforce contracts ranges from a low of 27 days in Tunisia to 1,439 days in Guatemala with an average of 399 days. This variable has been transformed from calendar days to months (calendar days/30). It is expected that the less time it takes for contracts to be settled, the more credit will be provided, which leads to higher levels of private credit.

Legal origin is widely used in the finance-growth literature as an element of creditor protections. Data on legal origins come from Djankov, Mcliesh, and Schleifer (2007) and are derived from the classifications put forward by La Porta, Lopez-de-Silanes, Schleifer, and Vishny (1997). Included are five basic classifications of legal origin: English, French, German, Nordic, and Soviet (in transition). English legal traditions include English common law and the current and former British colonies, whereas the French civil law includes the countries conquered by Napoleon and their

descendant colonies. This French classification includes Spain and Portugal and their respective colonies. Germanic legal origins include countries in central Europe and East Asia where they were transplanted while the Nordic legal origins is limited to the four Scandinavian countries. The Soviet legal systems refer to the countries in the former Soviet Union that have not reverted to the legal systems in place before Soviet control. For example, Latvia has German legal origins because they reverted to the legal structure they had before Soviet annexation. Dummy variables are assigned for French, German, Nordic, and Soviet legal origins with English origins being the null value.

4.4.4. Market Conditions

I control for the absolute level of income (*GDP.1999*) because larger economies may have larger credit markets because of the economies of scale in organizing a competitive market. At low levels of income, there may not be enough credit opportunities to foster enough competition between banks at the critical level to provide efficient financial services. The expected sign of this variable is positive as higher GDP would indicate higher private credit as a share of GDP. Growth of GDP (*GDP.Growth*) is controlled for because in times of high growth, lending can become more freely available and create higher levels of private credit. Rapid economic expansion may also require much higher levels of available credit as there may be a credit boom, which would justify an expected positive correlation. This variable is calculated as the average yearly growth rate percentage between 2007 and 2011 and is sourced from the World Bank World Development Indicators.

In addition to the level of income within a country, the amount of inequality within a country also has implications for the level of credit made available. At a given level of per capita income, higher levels of inequality will result in more unequal access as there will be more people below the threshold for having adequate funds to open an account when there are barriers to access. For this reason, I am controlling for inequality with the use of a GINI coefficient as calculated from the UNU-WIDER World Income Inequality Database, Version 2.0. The value used is the average of GINI coefficients over the time period 2001-2006. Within the WIDER database, there were occasions where multiple estimates are provided for the same country and year due to the collection of data from multiple sources. Each of these estimates is assigned a "quality" rating; in the event of multiple values, the estimates with the highest quality are used.

4.5. Model

The model employed in this paper is a cross-section of 120 countries. Although this procedure can omit important country characteristics, this is the only way to test the hypothesis that access is an important determinant of private credit due to the single data point for access to credit as described in the above section. The basic model incorporates creditor rights, information sharing, and market factor controls. To be clear, my primary dependent variable is private credit/GDP, not financial development. The basic model is as follows:

$$Private\ Credit = B_0 + B_1 Access + B_2 Creditor\ Rights + B_3 Information + B_4 Market\ Factors + \varepsilon \quad (4.2)$$

The first two sets of models presented in the results section face the same model selection as outlined by Djankov, McLiesh, and Shleifer (2007), using updated data. The next two models are specified in the same way, but include the added *access* and *ineq.access* variables to test for the impact of access to finance on private credit. Each of these two sets of models include a set of regressions including income, creditor rights, legal origins, and access, as well as a set of regressions swapping legal origins for the information sharing variables. The same model selection was then run for three country subsets: all countries, poor only, and rich only. The distinction between rich and poor is from the World Bank Classifications: high and upper-middle income is considered "rich," and low and lower-middle income were "poor." These designations were made to see whether the differences associated with access persist across income groups.

There were a couple models that exhibited heteroskedasticity. In order to reduce bias due to elevated levels of heteroskedasticity, I will control for these factors using a heteroskedasticity consistent standard errors (HCSE) model based on White (1980) and MacKinnon and White (1985). This method has shown its ability to control for heteroskedasticity within OLS estimations. However, White's estimator was developed for use with large samples; Long and Ervin (2000) present a new procedure to deal with heteroskedasticity in sample sizes under 250. It is argued that this procedure, known as HC3, is optimal as it does not alter the value of the coefficients and presents a consistent estimator of standard errors. These robust standard errors are used in every estimation as they do not distort estimates when heteroskedasticity is not present.

The third set of models includes the other market factors of income inequality as calculated with the GINI coefficient. Consistent estimates on the GINI coefficient are not

available for all countries in the sample. The sample was then reduced from 120 to 94 countries in order to accommodate this variable. The same subsets of rich/poor classifications will be used in all models in order to assess the differences in relative incomes. The remaining variables in these estimations are those that appear to be the most important in the earlier models. This set of models is included to control for underlying inequality that may explain much of the variation among access inequality.

4.6. Results

Within the empirical results, the findings of Djankov, McLiesh, and Schliefer (2007) are first replicated with results that differ only slightly from their initial findings. These are provided in order to directly compare my results from the inclusion of the access variables to the baseline estimations. The first set of results shown in Tables 4.2 and 4.3 are reproductions of the cross-sectional results as reported by Djankov et al. The differences in results found in my estimations can be attributed to an updated time sample (from 1999–2003 to 2007–2011) and a slightly reduced sample size (129 to 120). The sample size reduction is due to nine countries whose data were unavailable in the Global FINDEX database.

Table 4.2 displays the results for testing the effectiveness of creditor rights as proxied by the number of months it takes to enforce contracts through the court system, a constructed index of creditor rights, and legal origins. The control variables GDP and GDP per capita growth are significant, providing the expected direction of correlation. As expected, the measures of creditor rights were also significant, but were not significant in every model as they were in Djankov, Mcliesh, and Schleifer (2007). In the

sample that included all countries, the creditor rights were highly significant, yet diminished when the sample was split. The only apparent conflicting result was related to the Soviet legal origin. In Djankov, Mcliesh, and Schleifer's estimations, this was statistically significant and negative in the all country and rich country samples; however, in my model with the poor countries, Soviet legal origins were significant at the 10% level and *positive*. On the whole, the results related to creditor rights returned similar results in my updated sample.

The second set of cross-sectional estimates replaces the legal origins variables with the measures of information sharing with results shown in Table 4.3. All specifications in this updated sample remain the same. The creditor rights variables retain similar characteristics from the first set of models to this set. The information sharing variable shows statistical significance at the 1% level in the all country sample, but drops to 10% in each of the reduced samples. The interesting thing to note is that the individual components of information sharing, private bureau and public registry, do not appear to be large predictors of private credit. The only case was for private bureau in the all country sample. This was a drastic change from the Djankov, Mcliesh, and Schleifer estimations. My interpretation would be that over time the type of information sharing organization begins to matter less and less and that the important element is that some form of information sharing exists between creditors. The other possibility is that regardless of whether the information sharing entity is public or private the institutions function in a similar manner.

While there were differences between my estimates and those initially generated by Djankov, Mcliesh, and Schleifer, it can still be concluded that their conclusions that

creditor rights and information sharing are still large determinants of private credit. As such, we are now able to test the impact of the level of access and inequality of access using the same model specifications that provide baseline results. A further interpretation of the results follows.

The first set of models tests for the impact of access on private credit, controlling for market factors, creditor rights, and legal origins, while the second set of models replaces legal origins with information sharing and creditor rights. Both of these sets of models are separated by income group. In addition, there are additional estimates that control for the level of inequality, and these are reported in the third set of models. In each of these estimations, I find significant evidence in favor of the hypothesis that higher levels of access and lower inequalities of access are indicative of higher levels of private credit.

The first set of my access estimations are reported in Table 4.4. The results are separated into all countries, rich countries, and poor countries. Within each of these there are two base models: one of which controls for GDP and per capita GDP growth and elements of creditor rights, while the other includes these plus legal origins. The two access variables, *access* and *ineq.access*, are then estimated individually on these two base models.

Across all models in this set, both *access* and *ineq.access* enter as statistically significant. In the models that include all countries, access generates an average coefficient of 0.463, with a one standard deviation change from the mean of access generates a 11.1% change in private credit.[6] Although we find an economically and

[6] This log-log computation is performed as an elasticity by $e^{(B * \log(1+p)}$, where B is the coefficient and p is given as the percentage difference a one standard deviation change is from the mean value. Since the

statistically significant relationship, the possible endogeneity issue between private credit and total access makes it implausible to assert that access causes credit levels to change. The interesting thing to note is that when the countries are separated into rich and poor, there is a slightly larger effect on the rich countries. Computing the single standard deviation change from the mean has a 10.7% increase in private credit for rich countries compared to a 9.4% change for poor countries. This is somewhat surprising since countries typically will have more inclusive financial systems as they move up the development ladder. Within the wealthier countries, reductions in access to financial services are a larger impediment to allocations of capital.

The second and most important element of this research is the impact the level of unequal access to formal financial institutions (*ineq.access*) has on private credit. This variable enters into every regression significantly with the expected negative coefficient. As unequal access rises, the level of credit in the economy falls. The effect of changes in *ineq.access* has similar impacts on income groups. In the total sample, a one standard deviation increase in *ineq.access* results in estimates of private credit being only 70.4% of what it otherwise would have been[7]; conversely, a one standard deviation decrease in inequality would result in private credit estimates being a remarkable 42.1% higher. When separating the sample into income groups, this magnitude of the changes does fall somewhat, but remains influential; the one standard deviation decrease in *ineq.access* (reduced inequality) for the rich countries results in a 27.1% increase in the private credit

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mean and standard deviations change between samples, each elasticity is computed with their respective values.

[7] This log-linear computation is $e^{(0.4694*-0.749)}$, where 0.4694 represents one standard deviation and -0.749 being the average of the two ineq.access coefficients in the total sample. When computing the effects of a reduction in inequality of one standard deviation, 0.4694 become -0.4694. This is the method used when computing all other log-linear estimates.

ratio, compared to a 26.3% increase for the poor countries. The coefficients attached to *ineq.access* in each model exhibit the expected sign and statistical significance, providing substantial evidence for the theory that the distribution of access matters; it is not just the elite that should be targeted with financial services, but rather everyone in the economy.

The absolute level of GDP appears to be an important indicator of private credit as it enters significantly into every estimation. The coefficients between the rich and total sample remain relatively constant, increasing in the sample with only poor countries. This is expected as the poor countries have a lower GDP. This shows that the benefits to a large economy of mobilizing capital require economies of scale and the ability to have competition between financial institutions. Per capita GDP growth provided surprising results as it entered significantly into less than half the models. Growth was included because higher levels of growth are typically associated with increased lending in order to fuel the growth.

In accordance with the specification as laid forth by Djankov et al. (2007), contract enforcement (*cont.enforce*) was the number of months it took to settle a payment claim in the court system while the creditor rights index (*cred.rights*) is a constructed index on the ability of creditors to seize their collateral. Within these variables, some interesting results were found. In the complete sample with all countries, both variables entered into the regressions significantly and with the expected signs. However, in the rich country sample, only *cred.rights* was significant and *cont.enforce* was not, while neither variable is significant in the poor country sample. This indicates that in wealthy countries, it is not important how long it takes for creditors to receive their collateral back, but rather, that credit is increased when there are adequate creditor protections in

place. On the other hand, these creditor protections are not an important indicator for poor countries; the number of impediments to finance is wider than just creditor rights. This example is one in which it becomes apparent that splitting the samples into rich and poor can provide more information than the aggregated model is able to do, showing that a one-size-fits-all approach would not be beneficial in this case.

The introduction of legal origins as a factor of private credit is another element of creditor protections in that the way certain countries initial endowment of legal system has persistent carryover to modern times. The largest differences are normally attributed to the English versus French legal systems. The English common law is supposed to provide the most protections to creditors and should drive credit levels higher. However, the only legal origins variable that was statistically significant in either the full or rich country sample was Nordic in the fourth model at 5%, and was significant at the 10% level in the second model. In addition to this case *French* entered significantly into each of the poor country samples. The issue arises that the sign associated with this variable is positive and the opposite of what theory would predict; it is possible that this is an artifact of being within poor countries. Nordic legal origins were dropped from the regressions because there are not any poor Nordic countries. The other interesting result is that Soviet entered highly significant at the 1% level in a single model; these countries may have some relationship with how access is formulated because of the historical nature of the Soviet Union.

The second set of estimations is similar in structure to the first set; the only difference being the removal of legal origins and inserting the information sharing variables. Complete results are shown in Table 4.5. The results of these estimations do

not differ much from the results reported in the first set of models, but appear to provide a better fit than the first set as identified by the higher R-squared values in every model. The two access to finance variables displayed results quite similar to those from the first set of models—they are still significant at the 1% level and exhibit the expected sign. There are minor differences in the values of the coefficients, but not of great concern. In this table, increasing the level of access by one standard deviation generates an increase in private credit of 10.6%. It is evident that the coefficients between income groups differ widely, but when adjusted to the standard deviation changes the magnitude of the difference diminishes. The rich sample has a similar change to the total sample of 10.4%, but both the total sample and rich countries are larger than the poor sample impact of 8.8%. The impact of *ineq.access* in this set of models is slightly larger with a one standard deviation decrease in inequality equating to a 45.5% increase for the total sample, 35.6% for rich countries, and 30.2% for poor countries. The magnitude of the impact of the inequality of access is clearly an influential factor in the level of credit available in a given country. This result holds for countries both rich and poor, indicating that this impact is not limited to poor countries.

The one interesting change from the first set of models is that GDP becomes insignificant in the eighth model. This occurs under the rich country sample and only happens once the public registry and private bureau variables are inserted. Within these estimates, per capita GDP growth retains similar characteristics with some models being significant and others not, resulting in the inability to conclusively determine the impact of growth. The creditor rights variables (*cred.rights* and *cont.enforce*) exhibit the same phenomenon of both being significant in the total sample, yet alternating significance in

the reduced samples. The difference from the first estimations is that in half of the models statistical significance drops to the 10% level. However, the conclusions from these variables remains that reducing the time it takes to settle payment contracts in poor countries is optimal while strengthening creditor rights in wealthier countries is an optimal policy. The relationship between creditor rights and information sharing is that there are always imperfections in the way reforms are implemented; some reforms are more effective than others. As such, some countries may rely on creditor institutions while others will rely primarily on information sharing institutions. The effectiveness of the relative policies depends on the underlying characteristics of the countries—poorer countries are typically going to have difficulty with both effective legal systems and information transfers.

The variable information sharing is highly correlated with public registry and private bureau in that if either one is present then the information sharing dummy variable is assigned a value of one. Therefore, the model selection does not include both. The results show that in the full sample information sharing is an important factor, and that this is most likely attributed to the presence of a private bureau as evidenced by their statistical significance. These results carry over to the rich country sample with the expected signs but are not so decisive in the poor country sample. For poor countries, these information variables enter significantly in two of the four models; with those models it is significant in being the ones that include *ineq.access*. Of the information sharing variables, it appears as though the most important factor is whether a country has an institution that facilitates the transfer of information. On the question of whether these information sharing institutions should be a public or private company, these estimations

would indicate that a private bureau is more effective in increasing the level of credit in the economy. Determining the best course of action for facilitating this information transfer is of importance and unable to be discussed herein.

The final set of models was created in order to control for the level of income inequality and is shown in Table 4.6. Higher levels of inequality at a given income level could create a higher level of unequal access to financial institutions because of pushing a number of people below the threshold necessary for opening an account. Therefore, it is important to control for this factor in order to not overstate the effects of unequal access to credit. The model selection for this last set of models uses the most important explanatory variables from the earlier models. This includes GDP, per capita GDP growth, the creditor rights variables, and information sharing. The GINI coefficient is then added to this base model and estimated across the same sample classifications as the earlier models. Because GINI was not available for all countries in the sample, there was a reduction in the sample size from 120 to 94 countries.

Where it was expected that higher levels of GINI would contribute to lower private credit, this variable did not enter significantly in any of the models, regardless of which sample was used. This is an interesting result and runs in contrast to what theory would suggest. If the GINI coefficient were to appear significantly it would be most expected in the poor countries. The other variables exhibit their expected statistical significance and coefficient in the full sample of countries. However, in the reduced samples for rich and poor, much of this disappears. This is most evident in the poor country sample as the only variables to retain significance are the access variables and GDP. Much of this can probably be attributed to the reduced sample size.

The dominance of the access variables across models is consistent with the theory put forward in this essay that increasing access and decreasing the inequality of access to financial institutions reduces the level of credit in an economy. This is an important result in that private credit is often used as a proxy for financial development in studies that promote the development of financial services in order to increase growth. Karlan and Morduch (2009) acknowledge that while expanding access to financial services holds the promise of greatness, commercial banks have been unable to extend access to the poor and low-income households. Their research seeks to understand the particular factors that contribute to increasing access outside of the traditional elements of microfinance. Their conclusions are that the mechanisms through which credit are extended matter; the important part is determining the most appropriate lending mechanisms. More research on how to increase not only the level of access but the distribution of access across income groups is necessary.

4.7. Conclusion

On the heels of the body of research emerging regarding the impact of finance on economic development, a number of theorists have sought to determine exactly which types of institutions policy makers should be targeting in the development process. Two of the more prominent features possessed by The West are strong creditor protections and institutions designed to accommodate an efficient transfer of information. With a dominant proxy for financial development being the private credit/GDP ratio, assessing its relationship with specific institutions has a newfound importance. The legal and information institutions promise to increase the level of credit available within the

economy; econometric results have pointed toward policy prescriptions of strengthening these institutions.

Another set of reforms being implemented are creating inclusive financial services for their welfare implications. Outside of the immediate welfare impacts of creating an inclusive financial sector, it also has profound impacts on private credit. Two different measures of inclusiveness were used to evaluate their impacts on private credit using the brand new Global Financial Inclusion (FINDEX) database from the World Bank. The first variable is the traditional measure of the percentage of the adult population with an account at a formal financial institution. There is a robust positive relationship between access and private credit, measuring positive and statistically significant in every estimation. The result holds when using the complete sample, as well as when separating the countries into rich and poor. Due to the nature of having only a single data point for access and the close relationship with private credit, it is empirically difficult to definitively address causality. Therefore, while we are able to theorize that increasing access leads to increases in credit, we are only able to conclude that a relationship between the variables exists, with the use of the total access variable.

The second measure of inclusiveness, and the one I argue is most meaningful, is the equality of access which was unable to be computed before the emergence of the FINDEX data. The constructed variable measures the difference in access between the wealthier and poorer income groups. It is not clear that there are any endogeneity issues between private credit and *ineq.access,* as the level of credit does not determine distribution. Therefore, we are able to conclude that the distribution of access influences private credit. This result is statistically significant and negatively related in every

estimation, indicating that as an economy has more equal access, the level of credit will rise even controlling for a number of other factors.

The principle perspective to be gained from this research is that it is important to bring a larger percentage of people into the financial system. The secondary consideration is that the distribution of access among income groups matter as much as the percentage of the population. The poor face much larger impediments to finance than the rich, and as such, will find it more difficult to become engaged in the formal financial sector. Some basic policy advice is to remove the impediments to finance; especially those that affect the poor more. Some of these impediments, such as documentation requirements and large deposit requirements for opening an account, will not only increase the level of access to finance, but will also lend themselves to effective functioning business conditions. If the impediments to finance are burdensome document requirements, it can be surmised that there are numerous other hurdles to effectively get a business off the ground. The contributions of this research were to craft a new measure of financial inclusiveness and empirically show that inclusiveness has a large impact on the main proxy for financial development—private credit to GDP ratio.

Decreasing the inequality of access, as a measure of inclusiveness, involves not putting the poor subservient to the interests of the elite and involving more of the poor in the financial sector. If the advice of developing financial markets—as advocated in the majority of research on its relationship with growth—is accurate, this essay provides a compelling argument that decreasing the inequality of access to finance should lead to higher levels of private credit. The exact institutional structure of reforms is a current avenue of research being evaluated by a number of theorists working on the specifics

within microfinance that influence participants' access to financial services. These reforms, however, should first reduce the inequalities of access before attempting other reforms—such as opening a stock market—that purely target the elite. Some specific reforms include an expansion of microfinance institutions and increasing the availability of mobile banking institutions. Further research should target identifying the specific types of reforms that reduce the level of inequality, along with the proper methods for implementing those reforms.

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Table 4.1: Data Descriptions

Variable	Description (Source, year)
Private Credit	Refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits, and other accounts receivable, that establish a claim for repayment. Reported as a percentage of GDP. (World Bank World Development Indicators, Average of 2007-2011)
Access	Percent of population with account at formal financial institution. (World Bank Financial Inclusion Database, 2011)
Ineq.Access	Inequality of access measure computed by author as the percent difference between Bot.40 and Upp.60. *(upp.60 – low.40) / [(upp.60 + low.40) / 2]* (Authors calculations, 2011)
Low.40	Percent with account at formal financial institution, income in lower 40% (World Bank Financial Inclusion Database, 2011)
Upp.60	Percent with account at formal financial institution, income in upper 60% (World Bank Financial Inclusion Database, 2011)
GDP.2007	Absolute GDP, current US$ (World Bank World Development Indicators, 2007)
GDP.Growth	Average annual growth rate from 2007 to 2011, annual % (World Bank World Development Indicators, Average from 2007 to 2011)
Creditor Rights	An index aggregating creditor rights. This index ranges between 0 and 4, with higher values indicating more rights for creditors. (Djankov, McLeish, and Schleifer (2007),1999)
Information Sharing	If either a public or private bureau operate in the country this variable is assigned a value of one, zero otherwise. (Djankov, McLeish, and Schleifer (2007),1999)
Public Registry	If a public registry is in operation in a country, this variable is assigned a one, zero otherwise. A public registry is defined as a database owned by public authorities. (Djankov, McLeish, and Schleifer (2007),1999)
Private Bureau	If a private credit bureau operates in the country, this variable receives a value of one, zero otherwise. A private credit bureau is defined as a commercial or non-profit firm that maintains a database of firms and individuals, facilitating information transfers between banks and other financial institutions. (Djankov, McLeish, and Schleifer (2007),1999)
Contract Enforcement	The average amount of time it takes to resolve a payment dispute through courts. Only includes disputes worth 50 percent of the country's GDP. Computed as number of calendar days divided by 30. (Djankov, McLeish, and Schleifer (2007),2003)
Legal Origin	Dummy variables indentifying the legal origin of each country. The five origins are: English, French, German, Nordic, and Soviet. (La Porta et al. (1997) and CIA Factbook 2003; compiled by Djankov et. al (2007))
GINI	An index of income inequality ranging from perfect equality at zero to perfect inequality at one. (UNU-WIDER Income Inequality Database V2.0, Average of 2001-2006)

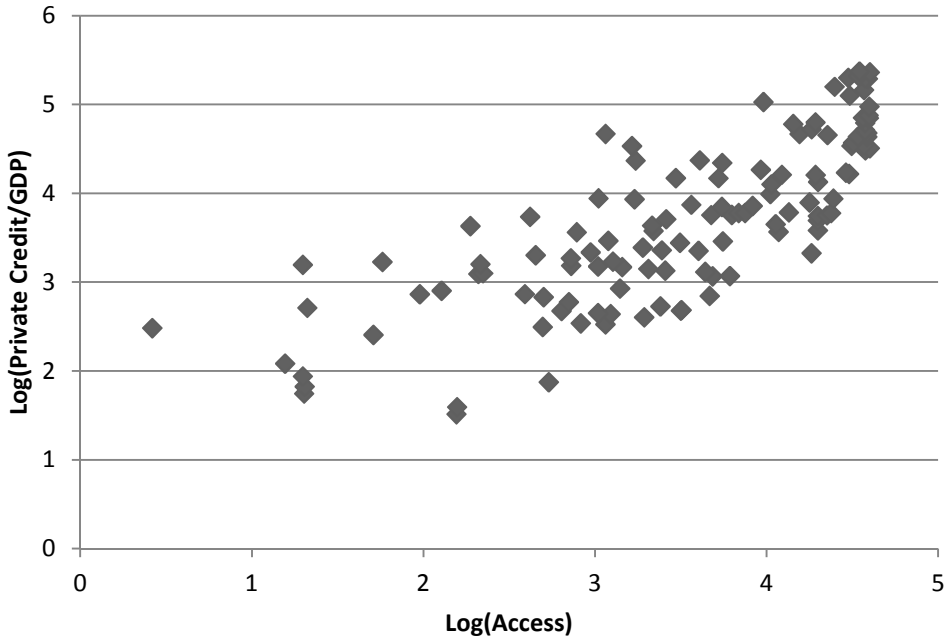

Figure 4.1: Private Credit ~ Access

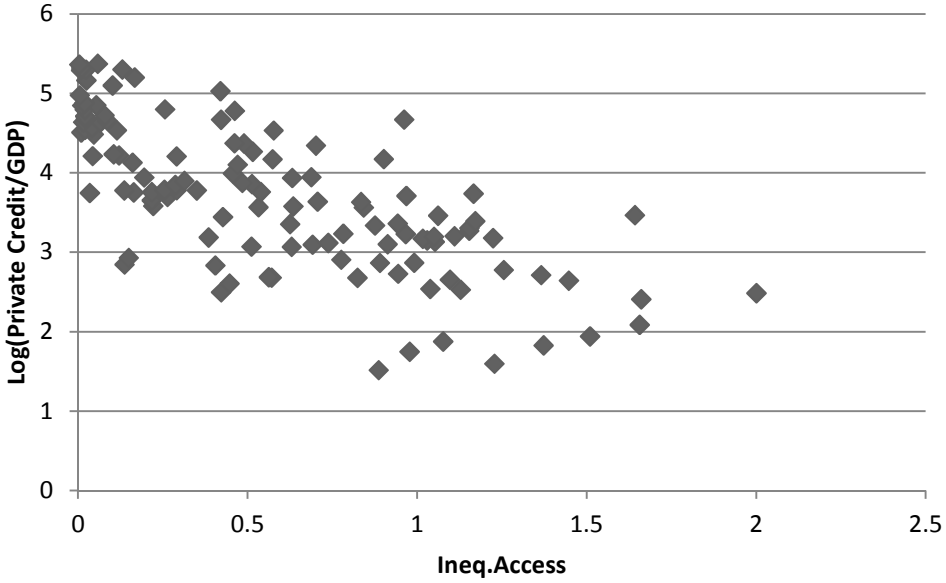

Figure 4.2: Private Credit ~ Ineq.Access

Table 4.2: Private Credit/GDP Regressions

	Dependent Variable: Private Credit/GDP (average 2005-2009)					
Independent Variables	All Countries		Rich Countries		Poor Countries	
GDP.07	0.264	0.256	0.178	0.177	0.233	0.264
	0.028***	0.028***	0.042***	0.043***	0.053***	0.059***
Percap Growth	-2.943	-2.535	-6.053	-5.003	2.141	1.678
	1.115**	1.172*	1.341***	1.51**	1.900	1.984
Contract Enforcement	-0.017	-0.018	-0.013	-0.011	-0.022	-0.027
	0.0068*	0.0071*	0.008	0.008	0.011'	0.012*
Creditor Rights	0.209	0.202	0.204	0.197	0.124	0.141
	0.047***	0.051***	0.060**	0.066**	0.076	0.081'
French		0.127		-0.134		0.388
		0.142		0.177		0.209'
German		0.328		-0.059		0.120
		0.184'		0.190		0.710
Nordic		0.686		0.375		(dropped)
		0.360'		0.326		
Soviet		0.115		-0.392		0.549
		0.222		0.306		0.304'
Constant	-2.784	-2.753	-0.325	-0.299	-2.43	-3.38
	0.723***	0.743***	1.192	1.243	1.212'	1.381*
Obs	120	120	64	64	56	56
R-sq	0.6040	0.6237	0.5500	0.5800	0.4133	0.4674

Note: Standard Errors below coefficients

Significance codes: ***=significant at 0.1%, **=significant at 1%, *=significant at 5%, '=significant at 10%

Table 4.3: Private Credit/GDP Regressions with Information Sharing

	Dependent Variable: Private Credit/GDP (average 2005-2009)					
Independent Variables	All Countries		Rich Countries		Poor Countries	
GDP.07	0.244	0.232	0.161	0.148	0.214	0.216
	0.28***	0.031***	0.043***	0.045**	0.053***	0.055***
Percap Growth	-2.516	-2.716	-5.54	-6.035	2.145	2.052
	1.090*	1.108*	1.350***	1.317***	1.86	1.909
Contract Enforcement	-0.019	-0.018	-0.014	-0.01	-0.024	-0.023
	0.0067**	0.0069*	0.0076'	0.008	0.011*	0.011*
Creditor Rights	0.224	0.207	0.191	0.196	0.169	0.151
	0.046***	.047***	0.060**	0.059**	0.078*	0.080'
Information Sharing	0.407		0.352		0.347	
	0.139**		0.200'		0.193'	
Public Registry		0.126		-0.051		0.242
		0.115		0.136		0.182
Private Bureau		0.301		0.266		0.29
		0.130*		0.143'		0.233
Constant	-2.657	-2.098	-0.185	0.307	-2.275	-2.237
	0.702***	0.771**	1.174	1.202	1.189'	1.233'
Obs	120	120	64	64	56	56
R-sq	0.6315	0.6231	0.5727	0.5810	0.4488	0.4459

Note: Standard Errors in parentheses

Significance codes: ***=significant at 0.1%, **=significant at 1%, *=significant at 5%, '=significant at 10%

Table 4.4: Private Credit/GDP Regressions

	Dependent Variable: Private Credit/GDP (average 2005-2009)											
Independent Variables	All Countries				Rich Countries				Poor Countries			
Access	0.462	0.464			0.702	0.744			0.358	0.386		
	0.068***	0.072***			0.179***	0.184***			0.107**	0.099***		
Ineq.Access			-0.755	-0.742			-0.767	-0.786			-0.576	-0.559
			0.126***	0.137***			0.273**	0.280**			0.214*	0.232*
GDP.07	0.137	0.139	0.174	0.173	0.12	0.113	0.137	0.136	0.166	0.19	0.197	0.221
	0.028***	0.029***	0.028***	0.029***	0.039**	0.045*	0.046**	0.053*	0.042***	0.051***	0.43***	0.054***
Percap Growth	-2.098	-2.079	-1.941	-1.609	-2.721	-2.603	-4.026	-3.151	0.613	0.052	0.917	0.734
	0.922*	1.046*	1.09'	1.171	1.341*	1.450'	1.479**	1.532*	1.717	2.010	2.082	2.435
Contract Enforcement	-0.014	-0.015	-0.018	-0.019	-0.009	-0.007	-0.011	-0.011	-0.017	-0.024	-0.025	-0.032
	0.005*	0.005**	0.006**	0.007**	0.006	0.006	0.005*	0.006'	0.014	0.016	0.019	0.024
Creditor Rights	0.104	0.127	0.133	0.154	0.123	0.173	0.14	0.146	0.053	0.08	0.103	0.136
	0.043*	0.047**	0.043**	0.046**	0.061*	0.074*	0.064*	0.076'	0.069	0.067	0.069	0.075'
French		0.202		0.150		0.046		-0.041		0.476		0.404
		0.127		0.125		0.192		0.198		0.179*		0.199*
German		0.111		0.157		-0.164		-0.099		0.267		0.173
		0.138		0.143		0.177		0.190		0.432		0.512
Nordic		0.414		0.406		0.221		0.244		(dropped)		(dropped)
		0.218'		0.197*		0.244		0.264				
Soviet		0.134		-0.044		-0.122		-0.445		0.532		0.373
		0.168		0.188		0.269		0.274		0.190**		0.226
Constant	-1.181	-1.382	-0.052	-0.165	-1.844	-1.91	0.954	0.979	-1.681	-2.561	-0.868	-1.674
	0.646'	0.688*	0.802	0.842	1.160	1.338	1.336	1.637	0.923'	1.182*	1.114	1.434
Obs	120	120	120	120	64	64	64	64	56	56	56	56
R-sq	0.7094	0.7189	0.6886	0.6973	0.6650	0.6822	0.6133	0.6385	0.5147	0.5824	0.4907	0.5354

Note: Standard Errors below coefficients

Significance codes: ***=significant at 0.1%, **=significant at 1%, *=significant at 5%, '=significant at 10%

Table 4.5: Private Credit/GDP Regressions with Information Sharing

	Dependent Variable: Private Credit/GDP (average 2005-2009)											
Independent Variables	All Countries				Rich Countries				Poor Countries			
Access	0.442	0.448			0.679	0.731			0.339	0.356		
	0.071***	0.069***			0.189**	0.171***			0.113**	0.117**		
Ineq.Access			-0.774	-0.824			-0.934	-1.04			-0.607	-0.677
			0.117***	0.112***			0.255**	0.263***			0.203**	0.193**
GDP.07	0.127	0.119	0.151	0.124	0.108	0.083	0.103	0.071	0.155	0.156	0.175	0.165
	0.027***	0.030***	0.026***	0.030***	0.038**	0.039*	0.040*	0.044	0.039***	0.040***	0.039***	0.040***
Percap Growth	-1.792	-1.982	-1.457	-1.549	-2.417	-2.564	-2.82	-3.299	0.698	0.395	0.855	0.677
	0.913'	0.929*	1.031	1.057	1.435'	1.290'	1.482'	1.356*	1.756	1.763	2.008	1.841
Contract Enforcement	-0.015	-0.015	-0.02	-0.019	-0.011	-0.007	-0.013	-0.009	-0.02	-0.018	-0.029	-0.028
	0.006**	0.005**	0.006**	0.006**	0.007	0.006	0.006*	0.005'	0.014	0.016	0.020	0.020
Creditor Rights	0.12	0.108	0.147	0.124	0.145	0.142	0.107	0.104	0.093	0.086	0.151	0.128
	0.044**	0.043*	0.043**	0.042**	0.059*	0.059*	0.062'	0.062'	0.071	0.075	0.069*	0.070'
Information Sharing	0.326		0.437		0.283		0.525		0.286		0.385	
	0.118**		0.113***		0.185		0.198*		0.151'		0.134**	
Public Registry		0.125		0.168		-0.062		0.0217		0.269		0.289
		0.096		0.097'		0.126		0.138		0.163		0.156'
Private Bureau		0.223		0.4		0.302		0.459		0.178		0.438
		0.104*		0.110***		0.131*		0.143**		0.196		0.228'
Constant	-1.149	-0.825	0.154	0.974	-1.682	-1.189	1.443	2.447	-1.597	-1.644	-0.616	-0.264
	0.603'	0.686	0.736	0.812	1.147	1.171	1.18	1.237'	0.868'	0.907'	1.045	1.038
Obs	120	120	120	120	64	64	64	64	56	56	56	56
R-sq	0.7269	0.7209	0.7203	0.7217	0.6796	0.705	0.6611	0.6839	0.5386	0.5429	0.5343	0.5481

Note: Standard Errors in parentheses

Significance codes: ***=significant at 0.1%, **=significant at 1%, *=significant at 5%, '=significant at 10%

Table 4.6: Regressions with GINI Coefficient

Independent Variables	Dependent Variable: Private Credit/GDP (average 2005-2009)					
	All Countries		Rich Countries		Poor Countries	
Access	0.425		0.580		0.334	
	0.081***		0.218*		0.130*	
Ineq.Access		-0.800		-0.709		-0.789
		0.160***		0.317*		0.222**
GDP.07	0.125	0.150	0.102	0.107	0.157	0.181
	0.033***	0.031***	0.044*	0.045*	0.057*	0.051**
Percap Growth	-0.995	-0.768	-3.385	-3.826	2.175	3.139
	1.025	1.045	1.637*	1.629*	2.019	1.760'
Contract Enforcement	-0.012	-0.014	-0.013	-0.013	-0.006	-0.013
	0.006'	0.006*	0.007'	0.007'	0.013	0.012
Creditor Rights	-0.012	0.152	0.126	0.105	0.114	0.147
	0.006'	0.049**	0.064'	0.068	0.088	0.082'
Information Sharing	0.309	0.414	0.229	0.451	0.236	0.235
	0.138*	0.137**	0.208	0.212*	0.206	0.192
GINI	-0.009	-0.002	-0.0003	-0.004	0.001	0.019
	0.006	0.007	0.009	0.009	0.013	0.012
Constant	-0.767	0.166	-0.951	1.528	-1.935	-1.718
	0.776	0.838	1.339	1.223	1.444	1.346
Obs	94	94	52	52	42	42
R-sq	0.7089	0.7014	0.6785	0.6648	0.5646	0.6206

Note: Standard Errors in parentheses

Significance codes: ***=significant at 0.1%, **=significant at 1%, *=significant at 5%, '=significant at 10%

CHAPTER 5

CONCLUSION

Each of the three essays of this dissertation examines how financial markets fit within the structure of a growing economy. The first essay, "Stock Markets and Growth: A Re-Evaluation," hypothesizes that the simple act of opening a stock market will not cause a permanent positive shock to economic growth rates. While there are certainly circumstances where the opening of a stock market will increase growth, it is not a policy that should be advocated in broad strokes. It is most likely that individual characteristics determine how effective a stock market will be in stimulating growth. The second essay, "Schumpeterian Innovation and Equity Issuance," evaluates one such case where firms use stock markets by positing that radically innovative firms in the earlier stages of the Schumpeterian innovation life cycle will be more likely to raise funds through the stock market relative to firms in more mature industries. Extending the result, it is possible that countries without a large amount of innovative activity will not be able to effectively leverage a stock market. As an element of financial development, stock markets and banks play different roles. The third essay, "Private Credit and Unequal Access," hypothesizes that an unequal distribution of access to formal financial markets will result in lower levels of credit being available in the economy. The basic recommendation

of this work is that until an inclusive financial sector has been developed, stock markets will be less effective.

"Stock Markets" hypothesizes that the opening of a stock market will not lead to a subsequent increase in the rate of economic growth. This runs contrary to much of the literature on the supposed impact of opening a stock market which posits that an efficient stock market is able to facilitate transfers between those with capital to entrepreneurs who are looking to expand their business. However, a number of theorists question whether stock markets are able to promote growth in developing countries. Some of the criticisms are that stock markets do not promote stability which can adversely affect an already fragile economy, leading to a negative relationship. The other argument is based around the premise that developing countries do not have a need or the ability to use stock markets; many of the countries without a stock market do not have legal structures to support an effective functioning market or have underlying characteristics that would be able to use the market. Whether opening a stock market leads to subsequent growth is an important question in light of the number of openings that occurred through the 1990s.

"Stock Markets" uses two Bayesian econometric methods, Extreme Bounds Analysis (EBA) and Bayesian Model Averaging (BMA), to determine the impact opening a stock market has on growth. To determine the impact of opening a stock market, two different explanatory variables are used with an additional 30 control variables included in the dataset. The first is a dummy variable equal to one if a stock market exists and zero if not. The second variable is the number of years the market has been open. Each of these variables is formed in this simplistic manner in order to test whether the presence actually will influence growth. EBA is able to determine the extreme bounds with which

a variable is able to take for a given dataset, finding that both the stock market variables are fragile and are not able to show that a relationship exists between opening a stock market and growth. Under BMA, the stock market variables fared no better, as posterior probabilities of being different from zero were 0.0. This means that in any of the top 73 models, neither variable would have been included. These Bayesian methodologies effectively question whether the opening of a stock market will influence growth.

"Schumpeter" examines one scenario where firms might be more likely to use stock market financing by positing that companies in the earlier phases of the Schumpeterian innovation life cycle will use more stock market financing relative to companies in mature industries. That firms in innovative industries use more funds from the stock market is based around the idea that banks are reluctant to loan funds in high risk industries with high potential returns. Although the firms may have a good risk-adjusted return, banks will not lend because of their limited return in the form of an interest rate, yet can lose their entire investment if the company defaults. When firms move through the Schumpeterian innovation life cycle their risk will diminish as they become acceptable for banks; before this time, the firms' only options are to sell equity in order to compensate the investors for the risk. This theory is placed within, and does not conflict with, the three dominant theories of capital structure: market timing, Pecking Order, and Trade-Off. A basic implication is that countries without large amounts of innovative activity may not have any use for a stock market. This would underline the results identifying that wealthier countries are market-based financial systems whereas poorer countries' financial systems are bank-based.

In evaluating whether firms raise more funds through the stock market at the beginning of the innovation life cycle, I empirically test whether firms in innovative industries will be more likely to use the stock market than firms in mature industries. Since more innovation occurs in the earlier phases of the life cycle, it is adequate to say that industries that are more innovative are located closer to the beginning of the life cycle. I estimate the relationship between innovation and stock market issuance with a probit model over the time period 1970–1992 and a 0/1 dependent variable of firm level decisions between stock and bond issuance. The variable of interest is innovation which is proxied by United States patent activity at the industry level which provided a positive and strongly statistically significant relationship with stock market issuance. This result provided support for the notion that firms in highly innovative industries at the beginning of the innovation life cycle will be more likely to raise funds through the stock market than firms in mature industries.

The third essay, "Private Credit," examines the most commonly used proxy of financial development, which has a close empirical relationship with growth, to ascertain the import elements underlying this proxy. Much of the evidence on the underlying components of the private credit/GDP ratio stresses creditor considerations: information sharing between creditors and legal rights for creditors to seize collateral. I hypothesize that the equality of access to formal financial markets positively influences the level of credit available in the economy through demand for financial services. This comes on the heels of conflicting evidence supporting the inclusiveness of financial services; some theorists contend that inclusive financial sectors will help lift the poor out of poverty, while others are unable to find any evidence that institutions such as microfinance are

able to promote growth or eradicate poverty. Basic economic theory argues that the distribution of finance does not matter and that it is allowing the elite within a society to have access to finance that is important. I have argued that a more equal distribution of financial services will lead to more credit availability through greater mobilization of capital and demand for financial services.

Recent research has shown that information sharing institutions, creditor rights, and legal structure all positively influence the private credit/GDP ratio. In testing the impact of inclusive financial systems, "Private Credit" uses identical empirical specifications and data as previous studies. The only differences are an updated time period and the inclusion of two access variables. Previously, the level of access was unable to be tested as there lacked reliable cross-country data on how people use accounts. With the release of the World Bank's Global Financial Indicators Database, this is able to be tested for the first time. One variable on access used is the percentage of the adult population with an account at a formal financial institution, which was positive and statistically significant in every estimation in accordance with theory. The second variable, and largest contributor to my research, is a variable of my construction on the distribution of access among income groups, where a higher value indicates higher inequality of access. This variable was an important indicator in every model with a negative, statistically significant result found. While I was able to replicate previous results, both access variables dominated the other control variables by providing substantial evidence that the distribution is important.

A number of policy prescriptions in the recent past have promoted the development of financial markets. There is a solid theoretical foundation for why

developed financial markets can help a country grow. However, in practice the result has not lived up to expectations; many of the empirical studies on financial markets have focused on countries in The West, extending the results to applications in developing countries. For this reason, it has become important to evaluate what the ideal institutional structure of financial markets looks like rather than promoting widespread development of financial markets. "Stock Markets" found that just opening a stock market is not enough to stimulate growth. While possible that stock markets can influence growth, they do not appear to do so broadly and should not be promoted unless other considerations are made.

One such idea as to the purpose of stock markets was evaluated in "Schumpeter" where stock markets are more effective for highly innovative industries. Extending this result, it may be the case that countries that import technologies from The West and are not actively engaged in radically new technologies may not be able to take advantage of a stock market. Future research will dictate whether the level of innovation within a country influences stock market activity and its impacts on growth. Additionally, as empirical evidence points to a relationship, it may be able to synthesize a unifying theory of capital structure incorporating the innovation life cycle. In evaluating whether financial markets can impact economic growth, "Private Credit" makes a compelling argument in favor of creating an inclusive financial sector first. One extension of this is that only after access has been extended to the economy would opening stock markets have an impact. The opening of a stock market may widen the inequality of access as the poor are typically unable to participate in common stock offerings. The literature on extending financial institutions to the poor has been rapidly expanding in recent years,

and it will be interesting to view how the inclusiveness influences private credit/GDP and growth in the future.